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The SCIENCE COUNSELOR

Volume XVII ★ Number 1 ★ March, 1954

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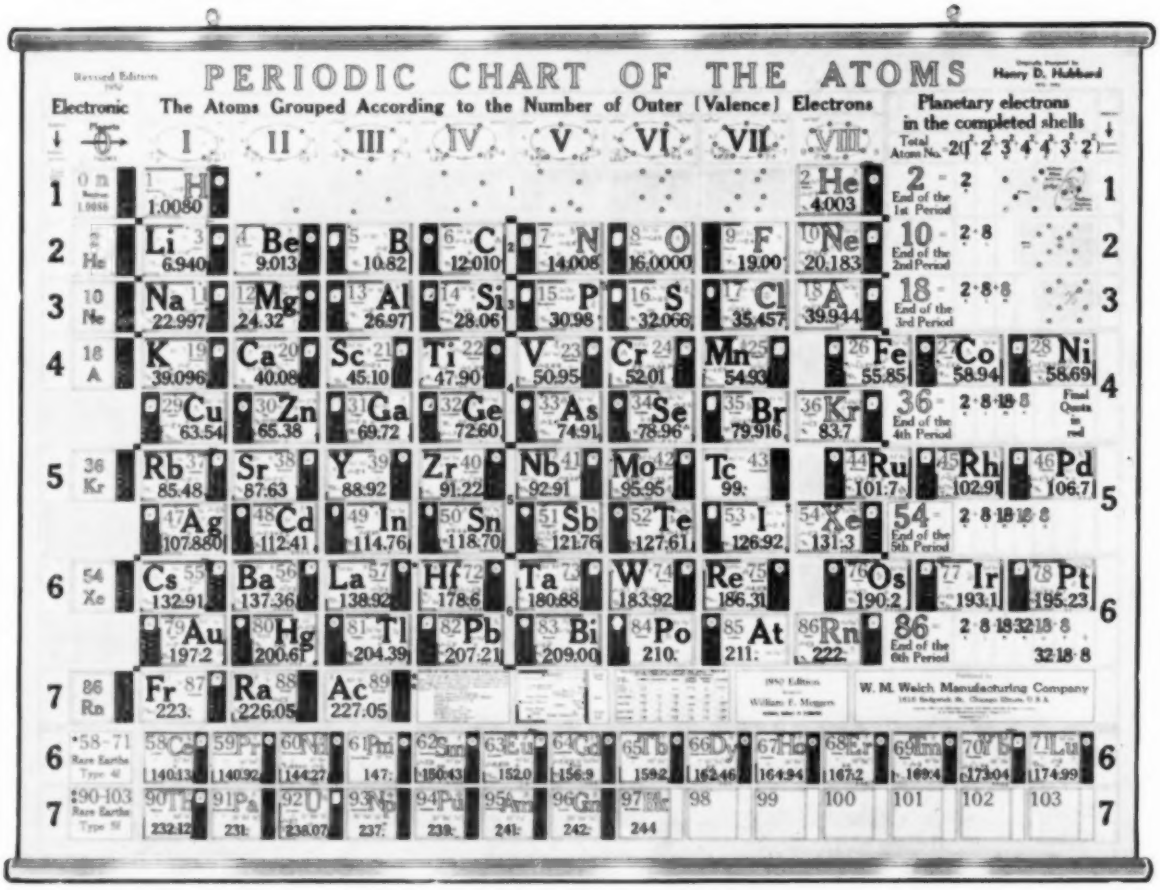

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The Diversified Support of Basic Research in the College

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Machine Tools, What They Are — What They Do

By Herbert L. Tigges, Vice-President, Baker Brothers, Inc., Toledo, Ohio, President, National Machine Tool Builders' Association.

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Hospital Pharmacy As a Career

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•

Fluoridation For Health

By Mary Lou Duggan, Marygrove College, Detroit, Michigan.

Cultivation of Food Plants in Dry Areas

● By S. Duvdevani
HEAD, DEW RESEARCH STATION, KARKUR, ISRAEL

The fact that dew benefits plant growth is a discovery that may find useful application in the cultivation of food plants in arid regions.

Dr. Duvdevani's studies prove that in plants water moves DOWNWARD from leaf to root, as well as from the soil upward. He describes here the research on which his findings are based.

A companion article dealing with dew measurement will appear in an early issue.

●

Life-supporting water can move *downward* from the leaves to the roots of various plants as well as upward from the soil. This has been shown in the California Institute of Technology's Earhart Plant Research Laboratory, a unique facility in which virtually all of the climatic factors influencing plant growth can be adjusted and fully controlled.

This fundamental finding sheds new light on the water economy of plants and introduces into plant physiology the concept of a two-way traffic in water supply. Previously it had been thought that the water used by plants travels only in one direction—upward from the roots to the leaves.

Eight species of plants were exposed to simulated dew in the form of a fine spray of water in the Earhart Laboratory. It was found that not only did the wetted leaves absorb water, but that the liquid moved through the full plant system and was excreted by the roots.

In this manner it was learned that dew condensing during the cool of the night can be stored in the soil and made available the next day when photosynthesis begins under the influence of sunlight. It may, therefore, be an important factor in arid zone agriculture.

That dew benefits plant growth was discovered in Israel by Shemuel Duvdevani, head of the Dew Research Station located at Karkur, and sponsored by the Research Council of Israel and the Ministry of Agriculture. His field studies, extending over a number of years, were made under arid summer conditions. In part, they involved comparing the growth of plants that received dew with that of plants screened by cloth canopies which allowed free circulation of air but prevented the condensation of dew.

He found the effect of dew to be pronounced, especially under conditions of low soil moisture. Growth as measured by the increased length of stems, the number and length of branches, and by the number and size of leaves, was appreciably greater among the bedewed plants. Cucumber plants showed vegetative gains as much as 50 per cent or more above the unbedewed specimens used as controls.

The difficulties of experimentation in the field—due to such factors as soil moisture deficiencies and the onset of fungus diseases (favored by dew conditions)—made the data on fruit-yield too random to warrant statistical analysis on a broad scale. In one year, however, the yield was 21 per cent greater for bedewed beans, and 50 per cent greater for cucumbers.

Duvdevani also found that soil moisture was about one per cent higher for young potted specimens of corn and beans that received dew. And during heavy dew seasons water droplets could be seen on the roots of certain plants (Bermuda grass, morning glory, and a mulberry tree) which were made visible in newly excavated soil trenches. These facts raised the possibility that the roots might be excreting dew water.

To verify this and to discover the effect of dew on plant life, Duvdevani came to the Earhart Laboratory in Pasadena as an Institute Research Fellow. There his experiments, supported by the Earhart Foundation and by the United Nations Educational, Scientific and Cultural Organization (UNESCO), could be conducted under highly controlled conditions and in a disease-free environment. He worked with partly-wilted specimens of tomato, bean, cucumber, water-melon, Brussels sprout, sugar beet, Coleus, and corn plants. He sealed their roots in empty glass jars, or in containers with soil, keeping a careful check on the sealing materials to insure that no leakage occurred. Their tops were exposed to water spray for eight to ten hours of the twenty-four, primarily at night to simulate dew as closely as possible.

The first sign of benefit from the spray was a gradual recovery from wilting in all the test plants. Experiments in which only a portion of the exposed plant top was sprayed showed that after the wetted parts became firmer and greener, the unmoistened parts recovered also. And whereas the wilting treatment had dried out many of the roots, new roots started to develop in great numbers. Clearly, water absorbed by the leaves was traveling through the plants.

Striking evidence that it was moving downward and out of the plants came when droplets formed on actively growing roots and began dripping off into the sealed containers. This usually happened two or more days, and never less than one, after the spraying began. The plants apparently used the available water first for their recovery. After their immediate needs were satisfied, they continued to take in water but gave off the excess for storage in the immediate vicinity of their roots.

As time passed, water accumulated in the containers in appreciable amounts. Seedlings of tomato and corn were especially active, sometimes excreting from six to ten times their own fresh weight during one simu-

(Continued on Page 37)

Some Experiments on the Kolbe Synthesis

● **By J. V. Karabinos, Ph.D.,** *(The Ohio State University)*
COLLEGE OF ST. FRANCIS, AND BLOCKSON CHEMICAL COMPANY, JOLIET, ILLINOIS

It has long been assumed that the electrolysis of the salts of organic acids produces in the paraffin fraction only normal, straight-chain hydrocarbons.

This is a report of a study which supports this belief.

Sodium caproate was electrolyzed and the decane fractions were shown by infrared absorption spectroscopy and freezing point determinations to contain no significant amount of branched-chain hydrocarbons.

●

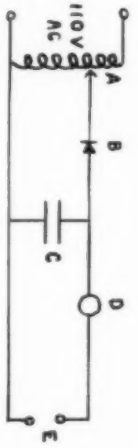

FIGURE 1. Electrical Circuit for the Kolbe Apparatus. A, 110-v variac; B, selenium rectifier, 0.5 Amp.; C, electrolytic condenser, 500 microfarad, 100-v; D, D.C./ ammeter, 0-1 Amp.; E, Kolbe electrolytic cell.

The preparation of hydrocarbons by electrolysis of organic acids, known as the Kolbe synthesis, may actually be traced back to Faraday[1] who, in 1834, showed that acetate solutions formed a hydrocarbon gas in an electric field. Kolbe[2], a few years later, elucidated the chemistry behind this reaction; hence the method bears his name. The conversion may be simply represented as:

$$2\ R\text{-}COO^- \rightarrow R\text{-}R + 2CO_2 + 2e$$

It is interesting that Kolbe at first set out to prepare the free radical "methyl" by electrolyzing acetic acid, and it only developed later that he had actually synthesized ethane. Even today the reaction is considered as going through a free radical mechanism.

Even though a variety of products have been obtained by the electrolysis of salts of other organic acids, the paraffin fraction, by far the largest single constituent, has always been assumed to consist exclusively of the normal, straight-chain hydrocarbons. In view of the fact that, *e.g.* the potassium salt of caproic acid reportedly[3] yields *n*-amyl caproate, *n*-amyl alcohol, 1-pentene, and probably 3-methyl-1-butene in addition to *n*-decane, it seemed highly desirable to reinvestigate the Kolbe reaction with special reference to the possible formation of branched-chain paraffins in the decane fraction. A compound such as 4-methylnonane could conceivably arise, *e.g.* from the action of the *n*-amyl radical on 1-pentene. With this in mind, sodium caproate was electrolyzed, in the modified apparatus (Fig. 1) described herein, and the decane fractions were shown by infrared absorption spectroscopy (Fig. 2) to consist mainly of *n*-decane.

Experimental Details

Apparatus.—The electrical portion of the apparatus, which furnishes a low amperage direct current (0.1 to 1 ampere) suitable for the Kolbe synthesis, was constructed as illustrated in Fig. 1. The electrolytic cell was usually immersed in a suitable cooling bath. It consisted of a test tube which contained two platinum gauze electrodes.

Electrolysis of Sodium Caproate.—In a typical experiment, in the apparatus described above, 67 g. of caproic acid, dissolved in 100 ml. of an aqueous solution containing 5 g. of sodium hydroxide, was electrolyzed for 43 hours, while externally cooled, at which

(Continued on Page 36)

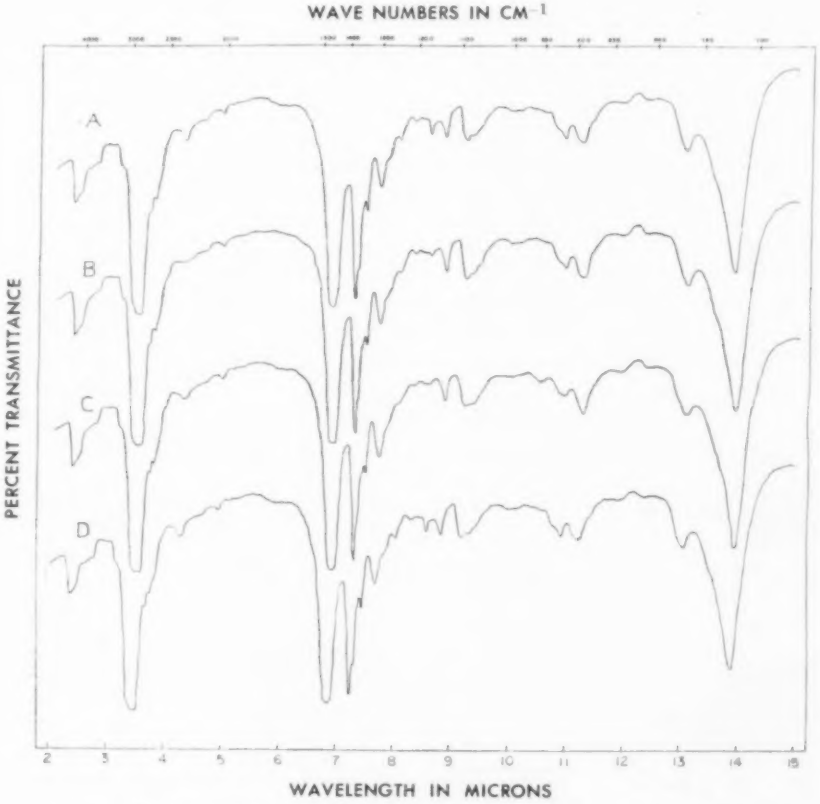

FIGURE 2. Infrared absorption spectra. A, fraction II (Table 1); B, fraction IV; C, fraction V; D, *n*-decane.

A World View of Chemistry --

Science -- A Cornerstone of Our Democracy

• By **Alfred B. Garrett, Ph.D.,** (*Ohio State University*)
PROFESSOR OF CHEMISTRY, McPHERSON CHEMICAL LABORATORY, OHIO STATE UNIVERSITY, COLUMBUS, OHIO

This paper was delivered as a special lecture in the Institute for the Teaching of Chemistry at St. Louis University, St. Louis, Missouri, during the Summer of 1953.

Dr. Garrett points out that leadership among nations is based in good part on leadership in science and on industrial vigor.

We have made many advances in science and technology. But as we advance in science we must also progress in human relationships. Scientists may no longer isolate themselves in their laboratories. They must help solve the human problems their discoveries create.

●

It is said that the United States has only 6 per cent of the world's population, yet she produces 25 per cent of the world's goods and possesses 50 per cent of the world's wealth. How has she arrived at this leading position in the world's family of nations?

Our resources. The United States has 40 per cent of the estimated mineral deposits of the world, 52 per cent of the coal deposits of the world, 61 per cent of the petroleum production of the world, and twice the iron deposits of all Europe. Between the Rocky Mountains and the Appalachians there are 1,000,000 square miles in favorable climate for agriculture, and more on the other side of these mountains. In one day's time the amount of solar energy striking the United States is equivalent to the energy released by 2,000,000 atomic bombs of the 20,000 ton TNT equivalent. Do these assets make us a great nation —a leader of nations?

Our scientific research activity. In the United States we have about 4000 scientific research laboratories; we publish more scientific research papers than any other nation (Table 1)[1]. Do these activities make us a great nation?

TABLE 1

Abstracts of Chemistry Papers Published in the Chemical Abstracts Journal from the Different Nations of the World.[1]

(Data given in percentages)

Countries	YEAR					
	1909	1917	1929	1940	1947	1951
United States	20.1	43.9	25.8	33.5	41.8	36.6
British Commonwealth	13.4	14.9	13.5	14.6	13.6	15.7
Japan	0.3	1.6	3.7	5.0	4.4	9.1
Germany	45.0	19.7	26.9	13.4	3.1	7.9
U.S.S.R.	1.2	2.5	3.4	14.1	8.2	6.3
France	13.2	7.6	7.0	5.3	8.4	6.2
Italy	1.2	2.9	3.0	3.4	3.8	3.3
Switzerland	----	1.1	1.1	1.0	2.8	1.9
The Netherlands	----	2.6	2.1	1.3	1.7	1.7
India	----	----	----	----	2.0	1.7
Austria	----	1.1	1.7	0.2	0.2	1.3
All others	5.6	2.1	11.8	8.2	12.0	8.3

The reasons for our leadership. We lead the nations today not because of the size of our population but because of:

1. Our natural resources,
2. Our scientific research activity,
3. Our excellent health (a result of research activity),
4. Our high skills, and
5. Our effective political and economic organization.

Our leadership in science is therefore an important element in establishing our leadership in the world family of nations; it is one of the cornerstones of our democracy. According to Dr. E. J. Crane, Editor of *Chemical Abstracts*[2], "Science is the principal source of growing industrial strength in a nation in time of peace. National strength depends not on the size of the population but upon the industrial vigor, which in turn is largely dependent upon scientific research activity." The field of science then takes on an added significance in the world order and it behooves us to take a world view of this great academic area.

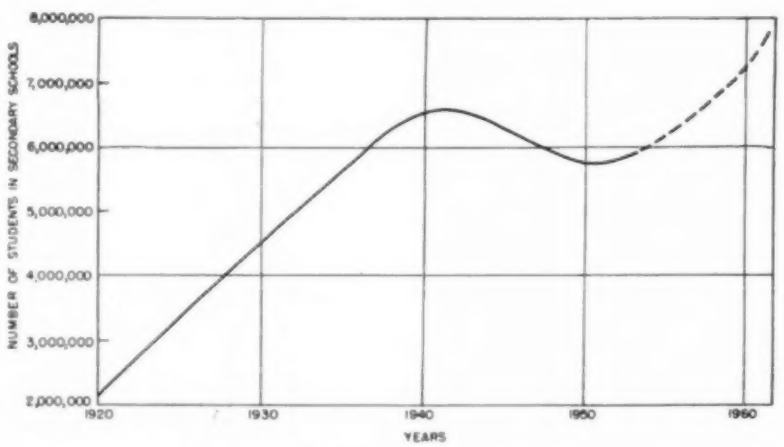

FIGURE 1. Trend in Secondary School Enrollment.

Some accomplishments in science and technology. Let us look at some of our accomplishments in the field of science and technology today.

We have gathered a considerable body of information about the composition, structure, and probable modes of motion of objects in this universe from the outermost parts of our galactic system to the nucleus of the atom—a range of distance from 100 light years of 1/1000 of 1/10,000 of an inch.

We know that the universe is made of a limited number of elementary substances, probably fewer than 100, and that each of these is composed of not more than 3 different fundamental particles—protons, neutrons and electrons.

We know why and how these elementary substances react to form compounds, and we have identified and prepared more than 660,000 different compounds of those elements.

We have considerable information about the gross structure and reactions that occur in plant and animal tissue.

We know the origin of the energy of the sun and the stars and have duplicated the process on a large scale by means of atomic bombs. We are now in the process of converting it to peacetime uses.

From the petroleum we can now synthesize all of the rubber we need and many of our modern plastics and fibers.

From the air we can "fix" all of the nitrogen we need.

From the sea water we extract all of the magnesium and a large percentage of the bromine we use.

We prepare gasoline, oil and many of our important compounds from coal.

We have developed pesticides that destroy insects, fungi and undesirable plants.

We have more than doubled the production of corn by hybridization and have developed superior strains of cereal crops.

The information that we have gathered about germs, viruses, enzymes, hormones, vitamins, toxins and antitoxins, antibiotics, drugs and medicines, anaesthetics and antiseptics has made it possible to almost double the life expectancy of man in the United States since the time of the Civil War, to increase it from 63 to 68 years in the last ten years.

We can cross the Atlantic Ocean in less than five hours, and cross our continent to the westward in the twilight period from the start of the setting sun until the last glow of the setting sun can be seen.

Economic importance of chemicals. Not only can we do these many things today so much easier and quicker than ever before, but the industries that they have stimulated to develop have become a very important part of our economic stability. The great chemical industry has become an even greater asset to the United States than the great iron and steel industry, which in the past has been considered the economic backbone of a great industrial nation. It is now recognized that "Chemicals must be considered the major industry of the United States . . . it cannot be matched by any other in dynamics, growth, earnings and potential for the future. More than any other it has found the power to create for itself and for men everywhere unlimited frontiers"[3].

Many scientific developments are recent. Not only is it important to recognize what we can do today as a result of the contributions of science and technology but we should also recognize how recently many of these developments came to us. Let us observe this by comparing the situation in the following three periods of the last forty years:

1. *At the start of the first World War (1914):*
   a. Farmers bought German potash and Chilean nitrate.
   b. Physicians bought European drugs, sutures and optical glass.
   c. Science got all leadership from Europe.
   d. All steel rusted.
   e. Rubber tires wore out in 3000 miles.
   f. Clothing textiles were the same as Caesar used.
   g. Paints on autos were the same as used by the builders of pyramids.
   h. Dyes were all made in Germany.
   i. Thousands of people died from diseases due to vitamin deficiency.
2. *At the close of the first World War:*
   a. The auto came of age.
   b. Aviation was established as a potent industry.
   c. Radio came into every home.
   d. Dyes were developed in America.
   e. We "fixed" our own nitrogen.
   f. Rayon was developed as a new textile.
   b. Sound movies became universal.
   h. Insulin was developed to cure diabetes.
   i. The American *led the world* in scientific training, publication and development.
3. *New developments now available this moment:*
   a. Hosiery, textiles, rubber and petroleum can be made from *coal*, *air* and *water*.
   b. Shoes can be made without leather and screening and bearings made without metal.
   c. Clothing and household furnishings can all be fire-proofed.
   d. Metals are used that are only 1/5 as heavy as iron.
   e. We can have automatic lighting and air conditioning for our homes.
   f. We have balanced vitamin diets.
   g. The sulfa drugs and antibiotics are available which are specific for blood poisoning, strep infections, gangrene, osteomyelitis, etc.

Science has raised our standard of living. These and many other contributions of science and technology

have raised our physical standard of living to the place where it is far beyond that of any other nation at any time in the world's history.

Importance of well-trained personnel. Basic to these contributions of science are the well-trained personnel in the fields of science, engineering and business who have the scientific and industrial "know how" which makes it possible to organize our scientific, techno-

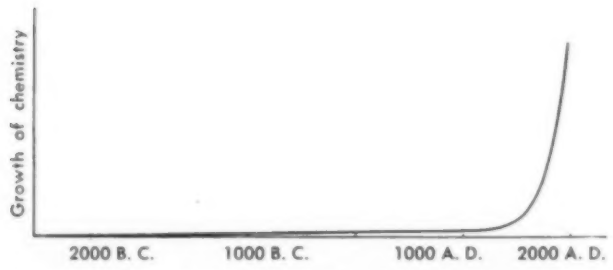

FIGURE 2. The Growth of Chemical Knowledge from Early Times to the Present.

logical and industrial resources. An excellent example of this is the "know how" that makes it possible to produce 100,000,000 tons of iron and steel in a twelve-month period, as we did in 1951, and to fabricate it into locomotives, ocean liners, bridges and sky scrapers.

The college training program for the youth of America has been a great asset in this respect. The following facts give a light of optimism to the assured development of the future leadership potential in these great technological and business areas of our complex economic system.

In 1953 about 4 per cent of the population of the U. S. A. have a college education; this is a significant increase over the situation of only 20 years ago—*in 1930* only about 1/3 as many people in the U. S. A. had a college education as now.

Not only have a greater per cent of people gone to college but the data indicate that in the immediate future there will be many many more students to go on to college. The trend in the secondary school enrollment shows this increase over the last thirty years and predicts a tremendous increase for the next fifteen years[4].

1920	2,199,389
1930	4,399,422
1940	6,601,444
1950	5,757,009
1960	7,237,000 (predicted)
1965 over	8,000,000 (predicted)

Hence we conclude that we should have a great leadership potential of well trained personnel in these rapidly developing scientific, technological and business areas for the future.

Our dwindling natural resources. This great development in science and technology in the United States has placed a heavy strain on our natural resources (See Table 2)[5]. We have used more of our natural resources in the last 50 years than were used in the previous 50 centuries. Today about 70 per cent of the things used in industrialized countries have their source in mines and quarries which are our *irreplaceable* resources. In the future science must find a much greater percentage of things to be used in industrialized countries from the *replaceable* elements of the soil.

Science is only one of our cornerstones. Science is truly a cornerstone of our democracy and a very important one; but it is not the only one and its very successes intensify for us many problems. Scientific and technological progress in the specialized fields in the past decade has been so breathtaking and bewildering that the implications of our own acts are now no longer clear to us. This area must be carefully studied to make it possible for us to understand ourselves, our own functions and possibilities in a complex world[6].

Science may make a more comfortable world, but it does not necessarily make a happier world. If science is to continue to develop effectively and be a constructive asset to civilization, it must have the support of a clear understanding of the basic principles and means of dealing with the problem of human relations. Otherwise our scientific assets can rapidly become liabilities. This means that we must not only recognize the *power* of science but also its *limitations*.

TABLE 2

Estimated Number of Years' Supply of Rich Deposits of Several Important Natural Resources

(Report by U. S. Bureau of Mines and Geological Survey)[5]

Coal	4000 years
Phosphate	600
Potash	100
Petroleum	20–100
Iron	76
Arsenic	50
Bismuth	36
Sulfur	36
Aluminum	23
Zinc	20
Copper	20
Cadmium	10
Lead	10

Our National Paradox. We find ourselves faced with the paradox: To maintain our position and compete in the family of nations, we must push on in science with utmost vigor[7]—but that very program can spell our doom unless we make significant progress in the areas of human relations. World leaders in science must be willing and prepared to step out of their laboratories and help solve some of the other problems that threaten to strangle and destroy their science. They must gather a clear perspective of these basic human problems of the world and lend every possible encouragement to the backward areas of the social science to accelerate their slow and plodding pace.

Another cornerstone to support our democracy. We now turn to another great area that must be developed—it is often termed "human engineering." It is a part of the development of the human side of science and

(Continued on Page 37)

Chemistry for the Non-College Student

● By Sister M. Aelred, O.S.F., M.S.Ed., *(Duquesne University)*
ST. WENDELIN HIGH SCHOOL, PITTSBURGH, PENNSYLVANIA, DIRECTOR OF PHYSICAL SCIENCE, DIOCESE OF PITTSBURGH

This paper considers some of the ways in which a high school course in chemistry can be adapted to meet the needs of the large number of pupils who will not enter college.

It was presented before a group of science teachers at a Diocesan Science and Mathematics Teachers Institute held recently at Duquesne University.

●

Adaptation is largely, if not solely, the satisfying of needs. When we consider the needs of the non-college student so far as chemistry is concerned, we can list his needs without great difficulty.

There is, of course, his need to arrive at eternal happiness, but his salvation depends upon the proper use of the things of his worldly environment. Therefore, the information and training the non-college student should receive through a chemistry course should be such as to enable him to use practically and intelligently the factors of the environment in which he expects to move. To achieve this will mean a curtailing of the usual content of chemical history and theory, the placing of emphasis on the practical applications of theories, and in addition learning what each student intends to do for his life work, if that is even vaguely clear in the student's mind. The kind of course I suggest will lie somewhere between a course in applied chemistry and one that is designed for a college preparatory group.

Since adaptation is largely a matter of filling needs, we should discuss those that seem basic to the student. I would have you remember, though, that what is more important than recognizing needs is this: *the student and the teacher should agree on the student's needs.* I realize that such an agreement can be brought about in many places other than a chemistry class, but it must be present in order to insure teaching success.

Let us first deal with the simple need for survival in any environment, the need to adjust, the need to perform certain actions with skill. In chemistry classes minor techniques are emphasized that may be utilized later in a bigger project, such as pouring liquids from the back of a bottle thereby saving the label from damage, or removing a stopper from a bottle in such a way that none of the contents which adhere to the stopper will come in contact with anything else. Chemistry gives much practice in these simple skills.

Second, and I am not listing these needs in any order of importance, the student has a right to know his rights and duties as a social being. Chemistry teachers have unusual opportunities to show the economic consequences of actions. Chemistry offers the student practice in working cooperatively with others. His respect for another's right to life and freedom from injury is shown in the care he uses in heating any mixture that sputters, or in pointing a test tube away from himself and from others when heating any material that generates a gas.

In a joint experiment, such as preparing chlorine whose fumes are so unpleasant and dangerous that commonly one doesn't permit the making of a number of experiments, each student is given a part; and, important or unimportant, it contributes to the success of the experiment.

Too often, in the pursuit of higher knowledge, many of the courtesies of life are forgotten. Witness to this fact was the vexation of the librarian of one of our local colleges on finding that a discourteous research student, anonymous of course, had torn entire pages from bound volumes of scientific periodicals. No knowledge can justify such conduct. Therefore, I make no apology for emphasizing the need for teaching courtesy and thoughtfulness to high school students.

As a consumer, the student will be taught countless little helps that will assist him in choosing the better product, such as the use of a solution of sodium hydroxide for testing woolen cloth, and the knowledge that using just *enough* soap is as effective as using a much larger amount.

Third, I point to physical fitness and good health as necessities for every student.

A rather detailed explanation of the chemistry of foods could well be given to the students in the kind of course we are describing. The simple chemical change of neutralizing an acid stomach condition with milk of magnesia, magnesium hydroxide, will interest him. Showing him that large doses of carbon dioxide can be fatal impresses him with the necessity for ventilating a room properly. He will never be burned with iodine if he is taught that tincture of iodine is pure iodine dissolved in alcohol. It becomes iodine again if the alcohol evaporates. He learns that water is not a substitute for alcohol in such a tincture.

Next, we point out that this especially adapted course will help to satisfy the student's need for understanding the scientific relations between man and his environment. Girls, especially, will be interested to learn that in beating a cake batter one folds the air *between* the mixture by movements in the same direction; mixing the air incorrectly results in a flat cake. A pressure cooker gives good results because evaporation and condensation are going on continuously and nothing good in the food is being lost. No man of the house will tolerate waste pipes without elbows because of the unwelcome odors when they are absent. He knows how the odors may be eliminated.

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Solar Energy for the Production of High Temperatures

• By Gene Braught
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For centuries, with varying degrees of success, man has sought to devise instruments by means of which he might utilize solar radiation directly as a source of power.

Here is an account of a successful sun furnace, designed by Dr. W. M. Conn of Rockhurst College. It has proved to be a valuable research tool. With it, temperatures can be raised from 20°C. to more than 3000°C. within a few seconds.

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The average intensity of solar radiation outside the atmosphere has been determined at 0.135 watt/cm^2. Since ancient times men have dreamed of collecting and utilizing this energy directly. It is said that Archimedes, using solar energy concentrated by articulated mirrors, attempted to set fire to the Roman fleet besieging Syracuse. Lavoisier, by means of a four-foot lens, demonstrated the value of solar radiation as a high temperature energy source, and succeeded in melting platinum at 1773°C[1].

Efforts toward the application of solar energy to the production of steam power resulted in the showing

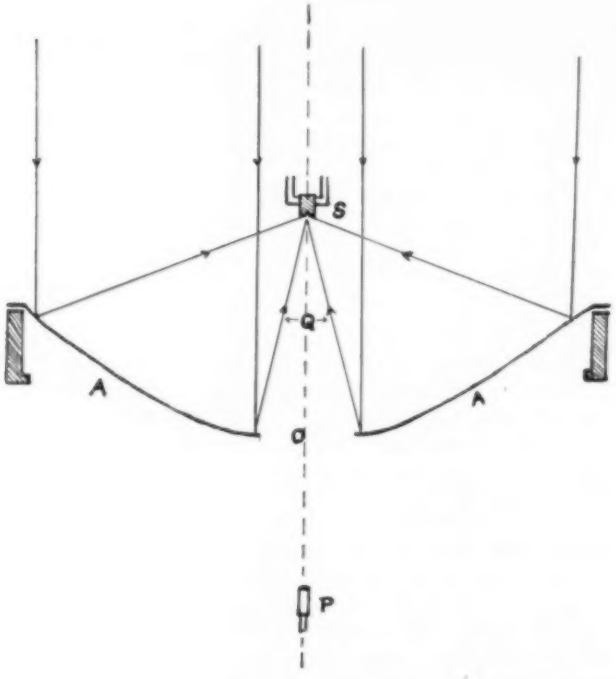

FIGURE 1. The optical system of the Solar Furnace at Rockhurst College. A, mirror; S, sample; P, optical pyrometer; Q, shadow zone.

FIGURE 2. The Solar Furnace at Rockhurst College designed by Dr. W. M. Conn.

at the Paris Exhibition in 1878 of a device with a conical receiver of 20 m^2 which supplied steam to an engine of 0.986 hp.[2].

At the turn of the century elaborate systems were constructed at various places. These developments cumulated in the Shuman-Boys absorber, completed at Meadi, Egypt in 1913. This apparatus consisted of a series of trough reflectors with parabolic cross section and with a total effective area of reflecting surface of 10,296 sq. ft. Each mirror was equipped with a water filled heater tube mounted within the focal area, and connected to a steam main which eventually led to the engine.

Operating with a peak thermal efficiency of 40.1 per cent, this system could produce for one hour 55.5 brake-horsepower.

Subsequently this irrigation project was abandoned as were other attempts of a similar nature, due to local disadvantages of maintenance of equipment as compared to coal and oil installations for power production.

Among the more obvious limitations of this use of solar energy may be mentioned the small amount of energy incident per unit area, for the value of the solar constant as given above is, even under good conditions, reduced on the average to approximately 0.08 watt/cm^2 at the earth's surface. The fact that operations are at best limited to daytime and are completely dependent on weather conditions, must be taken into consideration. Also, maintaining large reflecting areas at even moderate efficiency in a corrosive and dust-laden atmosphere is a problem of no small magnitude.

However, efforts to utilize solar energy in high temperature research have been more successful. We have referred to Lavoisier's attempt to melt platinum. But, it was not until 1921 that R. Straubel in Jena set up the first reflector type solar furnace. Using glass searchlight mirrors of 79 in. aperture and 35 in. focal length he obtained, under good conditions, an estimated temperature of 4000°C., sufficient to melt substances such as ZrO_2 and Al_2O_3[5].

In 1946, Trombe and co-workers obtained large searchlight mirrors and set up a solar laboratory at Meudon near Paris. Temperatures attained were in excess of 3000°C. and various refractory oxides were melted[1]. A plane secondary mirror was placed behind the focus so that the radiation could be re-reflected downward into a crucible containing the material to be tested.

Continuation of this research along semi-industrial lines led to the construction in 1952 of a compound furnace at Mont Louis in the Eastern Pyrenees. The principal members of this apparatus were a 35 ft. parabolic reflector coupled to a 43 ft. × 34 ft. heliostat mirror. The converging mirror was articulated, and each of the 3500 plates that composed its surface was slightly curved in order to reduce the size of the image. The equivalent energy concentrated at the focus by the superposition of the images produced by the segments was given at approximately 75 kw[3]. The operating temperature ranged from 2500°C. to 2600°C.

In 1940, Dr. W. M. Conn designed a 120 in. solar furnace for the A.C. Spark Plug Division, General Motors Corporation. Becoming surplus in 1946, it was subsequently moved to Rockhurst College. This instrument was designed primarily for research purposes and for the production of the maximum practicable temperature over a small area where a well defined image of the sun was formed.

The optical system of the solar furnace is shown in Fig. 1. The rays of the sun fall upon the parabolic mirror A, and are concentrated on the sample S. To obtain quantitative temperature measurements, an optical pyrometer P is set in the axis of the mirror and focussed on S. The opening O creates a shadow cone Q, with its apex near S.

Fig. 2 shows a photograph of the solar furnace in use at Rockhurst College. The aluminum mirror of 120 in. diameter and 34 in. focal length, is mounted on a circular steel ring. The latter is mounted within the oval ring of the polar axis. The furnace follows the apparent movement of the sun by means of the 13 ft. lever seen at the left. This lever is weighted and its rate of descent along the inclined plane, partly visible in the Figure, is controlled by an astronomical clock with fly-ball governor[6].

In Fig. 3 the solar furnace is seen from the west. When this photograph was taken an auxiliary 60 in. mirror had been mounted such that its focal point coincided with that of the larger reflector[7].

To control the amount of incident radiation and thereby the temperature at the focus, an aluminum cylinder was mounted along the axis of the mirror such that as it was advanced and withdrawn it intercepted a greater or less amount of the reflected sunlight. The cylinder was operated through a motor drive with a degree of control that permitted adjustments within ±2°C. up to 2000°C.

Samples in the form of blocks or rods were moved into the focal area on a motor driven mount. Actually, all refractory substances that can be heated in an oxidizing atmosphere have been melted or sublimed, including such materials as zirconia and thoria.

In a general discussion of the advantages obtained through the use of a solar furnace in the production of high temperatures, the peculiar nature and pliancy of the heat source attracts attention. The temperature

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FIGURE 3. A general view of the Rockhurst Solar Furnace from the west. Note the auxiliary mirror.

The Search for Plasma Volume Expanders

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Countless human lives have been saved by the transfusion of blood, and by the use of products derived from blood.

But blood varies in its nature, it coagulates quickly, and it is difficult to preserve. Difficulties such as these have been overcome to a considerable extent, and blood banks are now commonplace. But the supply of human blood will always be limited. Although actually there can be no substitute for blood, suitable replacements for plasma—plasma volume expanders—have been sought with encouraging success.

One of the most recent is dextran, a name which denotes a group of giant-molecule, glucose polysaccharides produced by the action of certain bacteria on sugar solutions. This up-to-the-minute article is mainly a story of its discovery and production, and its present status in medicine.

●

One of the triumphs of twentieth century medicine has been the saving of human life through the use of whole blood and products derived from blood. From antiquity, blood has been regarded as a vital fluid which sustains life itself, and medical history records attempts to transfuse human blood even before the circulation of blood was discovered and elaborated by the great scientist Harvey in the seventeenth century.

It was not until our own century, however, that methods for preventing blood coagulation, apparatus for collecting blood, methods for the preservation of blood, and a knowledge of blood types made its use in medicine practical. During World War I a few blood transfusions were carried out in Army hospitals near the front line and the value of blood in hemorrhage and wound shock was definitely established, but it was not until the late 1930's that blood banks developed on a large scale. Although there are conflicting claims, the first blood bank was probably established at the Cook County Hospital in Chicago in 1937. By that time methods had been discovered for preserving blood for a period of about two weeks.

The ancients were correct in their estimation of the importance of blood for the maintenance of life. Each of the untold billion of cells which make up a human body must be supplied with oxygen and food materials, and the waste products of cell metabolism such as urea, and uric acid must be removed. For accomplishing these necessary ends, nature has developed an elaborate circulatory system made up literally of miles of "pipe line," the veins, arteries and capillaries, through which the blood flows ceaselessly. Oxygen is transported from the lungs by the hemoglobin which is contained in the red cells of the blood, and carbon dioxide is removed as sodium bicarbonate from the tissues and transported to the lungs for expiration. When the red cells are removed from blood, blood plasma is left. This is a straw-colored, viscous solution in which is dissolved plasma proteins to the extent of about 7 grams per hundred milliliters. Plasma also contains glucose, amino acids, fats, and other essential nutrients, as well as the vitamins and hormones which are essential for normal cell metabolism. There are also present in the plasma small amounts of the waste products of metabolism which have not yet been removed from the circulation by the kidney and excreted from the body.

In addition to all this, blood plasma has another very important function, the maintenance of water balance in the body. There is a constant interchange of water between the circulatory system and the tissues. One of the principal functions of the plasma proteins, which have molecular weights ranging from 50,000 to about 500,000, is to prevent too much water from leaving the circulation. If no osmotically active plasma proteins were present in blood, water would leak out into the tissues and circulation would greatly diminish. It is therefore essential that large molecular weight substances, too large to pass through the capillary walls readily, be present in the circulation in order to maintain the blood volume at the proper level.

When the human organism is injured, several things may happen. Almost always the victim becomes cold and clammy, the heart beat is speeded up, and he is said to be in a state known to the physician as the shock syndrome. Blood vessels may be severed and a large amount of blood may be lost. But even in injuries in which there is little hemorrhage there is usually a decrease in effective circulating blood volume. The reason for this and the mechanism behind it are not well understood, but it is well established that shock is usually associated with subnormal blood volumes, and a lowered blood pressure. In order to treat shock, it is essential to administer whole blood, or if there has been no great loss of blood (and hence erythrocytes), to administer human plasma or some other equivalent osmotically active material.

Since it is the red blood cells which break down on storage, medical investigators very logically began to study the use of blood plasma for the treatment of shock. By the time the United States entered World War II, the use of plasma and methods for its preparation were well worked out and many millions of pints of blood were collected from the citizens of the United States for the preparation of plasma for use by the Armed Forces. One of the most useful advances was the development of dried plasma, prepared by lyophilizing blood plasma. In this process, the serum is

frozen and the water removed from the frozen state in a high vacuum. This dried plasma will keep for years and is readily reconstituted by dissolving in water or saline just prior to use. It was found that plasma was quite a satisfactory treatment for shock, especially when hemorrhage was minimal, and since the factors which are involved in blood types are all associated with the red cells, anyone's plasma could safely be given to any other individual.

Long before human plasma was developed a search was started for an osmotically active material which could be used for the treatment of shock, a substance which would expand the plasma volume, and thus relieve the symptoms of shock. This type of medicinal agent has come to be known as a plasma volume expander. During World War I a complex polysaccharide known as Gum Acacia was used for the treatment of war casualties. There were no immediate toxic effects when this material was used and it did have the desired effect, namely, the immediate relief of shock. Some years later, however, it was found that the gum acacia had not all been excreted, but had been stored in the liver and other organs of these patients and the question arose naturally as to whether such storage was detrimental.

The ideal plasma volume expander will not cause any undesirable or toxic side effects, will be completely metabolized and hence will not be stored, will not be antigenic and sensitize patients toward a second dose of the plasma volume expander, and will maintain an expanded blood volume for at least 6 hours. In addition to these qualities, it should also be a substance which can be produced in any desired quantity, will be stable on storage without refrigeration, and will be relatively inexpensive.

Very little was accomplished in the search for plasma volume expanders from World War I until about 1940. At that time the German Army was faced with a critical situation, since it was deemed impossible to provide whole blood or plasma for the casualties to be expected in the war which was about to be launched. For this reason, German medical investigators were assigned the problem of finding a readily available synthetic material which would be suitable for the treatment of shock. They developed a synthetic polymer of vinylpyrrolidone which has been known by several names but which is now known as PVP (polyvinylpyrrolidone). Although this material was successfully used by the Germans in thousands of war casualties and although the material was satisfactory with respect to its immediate effects in relieving shock, very little was known at that time concerning its physiological effects. Recent work in the United States has shown that a fraction of the administered PVP is stored in the body but it has not been proved that this storage actually leads to undesirable side effects. Research on this material is still being intensively pursued. Many other plasma volume expanders, including gelatin, pectin and dextran have been proposed. Currently, the latter substance is considered one of the best of the group, and most of what follows will be concerned with the development of dextran for this purpose.

Dextran is a polysaccharide made up solely of glucose units. It has been known for many years as a biosynthetic product of certain types of bacteria. Indeed, it has been known for a century as an undesirable product of the sugar beet refining industry and it is always present in small amounts in ordinary table sugar, sucrose. Dextran-producing bacteria grow well on a sucrose medium and it is almost impossible to keep the bacteria completely out of sucrose solutions in the intermediate stages of sugar refining. The bacteria are able to polymerize the glucose part of the sucrose molecule to form dextran and the other half, fructose, is used as a source of energy for growth. Giant molecules containing thousands of glucose units are elaborated, having molecular weights of 10,000,000 or more. The dextran remains dissolved in the fermentation medium which becomes quite thick and viscous.

Until recently dextran was considered a single structural entity. Further investigation in a number of laboratories has shown, however, that there are many different structural types of dextran even though they are all alike in being made up entirely of glucose units. It has been found that the many different structural types of dextran contain a high proportion α 1-6 glycosidic linkages. It is now quite clear that dextran should be considered a generic term for a group of glucose polysaccharides in which from 60 to 100 per cent of the linkages between the individual glucose molecules are α 1-6 glycosidic linkages. A glucose polymer containing only this one type of linkage would be a completely linear molecule in which the individual glucose units are linked from the tail end of one molecule (carbon 6) to the head end of the next molecule (carbon 1).

Since there are no other naturally occurring glucose polymers known which contain as high as 60 per cent 1-6 linkages, dextrans form a distinct group of polysaccharides. The non 1-6 linkages were originally thought to be all α 1-4 but are now known to be, in some cases, 1-3 links, and the possibility is not excluded that there may also be some 1-2 links in some dextrans.

At the Northern Regional Research Laboratory, U. S. Department of Agriculture, in Peoria, Illinois, more than 100 dextran producing bacterial strains have been investigated and it has been found that they produce almost this many types of dextran, differing in molecular size, molecular shape and the extent of branching. The dextran type of glucose polymer can be compared to ordinary starch in which the individual units are joined for the most part through α 1-4 linkages and only a few 1-6 linkages are present. In the dextran molecule, the non 1-6 linkages represent points at which side branches are attached to the main chain. Thus, the greater the percentage of 1-6 linkages the less branched and the more linear the molecule is. If so many different types of dextran exist, it is not to be expected that all types will behave physiologically in exactly the same way.

About ten years ago, two Swedish investigators, Groenwall and Ingelman, proposed the use of dextran solutions for the treatment of shock. They found that

native, high molecular weight dextran is toxic, but that after acid hydrolysis to a sufficiently low molecular weight range, the dextran was non-toxic. In such a chemical degradation process, it is not to be expected that the molecules will all be of the same size. Therefore, the problem presented itself of fractionating out a certain range of molecular sizes which might be suitable for transfusion into humans.

The Swedish investigators prepared a dextran in which most of the molecules had molecular weights of less than 500,000. The Swedish dextran product was used in Sweden and several other European countries with fair success. But then a strange thing happened. When the Swedish dextran was tried in the United States on normal people, a large percentage of the human subjects exhibited undesirable side reactions, and it was tentatively concluded by American investigators that this dextran was not suitable for widespread use. These unfavorable reports on dextran could mean either that the structural type of dextran used was unsuitable or that the dextran had not been properly prepared and purified. Many of these reactions were mild and were nothing more than slight cases of hives, but others appeared to be more serious.

In 1949, we decided to investigate the dextran problem and see if it would be possible to produce a preparation which would be free of the undesirable side reactions seen with the European product. When the dextran project was first proposed, many of the laboratory personnel were lukewarm because they were familiar with the shortcomings and the failure of other expanders that had been proposed and tried clinically. To a certain extent, we agreed with the prevailing view in American medicine that nothing could be or should be injected into the human circulation except human blood or human blood products. However, in view of the apparent urgency of the problem and the necessity of finding a suitable material for stock piling against the day of civilian atomic bombings or atomic war disaster situations, we proceeded with the project.

At the very beginning, in the absence of precise information, we made certain basic assumptions. We decided to prepare a product which would be as homogeneous in size as was practical, and which would have an average molecular weight close to that as serum albumin. We also proceeded on the assumption that the most satisfactory dextran would be one with the simplest possible structure; in other words, a dextran which was not very highly branched. This was based on the premise that the simpler the structure the less chance there would be for anaphylactic reactions with polysaccharide antibodies which might normally be present in humans. It also seemed possible to us that a simple structure would be less likely to be antigenic *per se* and so would not sensitize the recipients of dextran to further administration.

Proceeding along these lines, we chose the bacterial strain *Leuconostoc mesenteroides* B-512 which was one of the strains in the collection of dextran producing organisms available at the Northern Regional Research Laboratory, Peoria, Illinois, a strain which produced a much more linear type of dextran than that which was used for the preparation of the European dextran product. Before many months we had prepared a clinical dextran embodying these concepts and it was sent out for clinical trial. The first twelve pints of product, bottled by hand, were sent to Dr. Walter L. Bloom at Emory University to try on patients. Almost every possible physiological measurement known to modern medical science was made on the patients that received this first experimental American dextran. The results were so encouraging that other researchers began exhaustive human and animal experiments.

Meanwhile, the Armed Forces and the Civilian Defense authorities were vitally interested in a suitable plasma volume expander, and they asked the National Research Council in Washington, D. C., to take over the supervision of dextran research for the United States. One of the reasons for the interest of the Armed Forces in plasma volume expanders was their experience with plasma in the recent Korean conflict. They found that a rather high percentage of the recipients of blood plasma contracted a disease known as infective jaundice, or hepatitis. This is known to be caused by a virus which is sometimes present in blood plasma and which cannot be removed or inactivated by any known technique. This disease, though not often fatal, is quite serious and often incapacitates its victims for a year or longer. But as long as no good replacement was available plasma had to be used, even in the face of the known risk of spreading hepatitis. Moreover, the Army was anxious to be assured of unlimited supplies of a suitable substitute for plasma, one which did not depend upon the collection of blood from the civilian population.

Dextran research in the United States has been conducted under the auspices of the National Research Council for about four years and is still going on in a large number of medical schools. Let us see how well the American type of dextran measures up to the requirements for a good plasma volume expander given above.

Does dextran cause undesirable side reactions? The percentage of undesirable reactions to dextran, when administered to normal humans and to patients in shock, is of the order of one per cent or less. This reaction rate is even less than that for plasma or whole blood.

Is dextran permanently stored in the tissues or in the body organs and does it impair the normal functioning of these organs? Rather extended research has shown that the normal functions of the liver and kidney and other organs are not affected until very large amounts of dextran are administered, much more than would normally be given to any patient in need of treatment. In order to answer the question of storage, dextran was prepared from sucrose randomly labelled with radioactive carbon, C^{14}. The resulting C^{14} labelled native dextran was processed to produce a clinical dextran identical with the product which had been clinically tested except that it contained a small amount of radioactive carbon. Extensive experiments in mice, rats, dogs, and humans have shown rather

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Human Geography

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Don't fail to read this convincing article!

Perhaps you are one of the many who do not realize how sadly the study of human geography has been neglected in this country. We know far too little about other lands and other peoples to provide them with the intelligent leadership that our present rank among nations demands.

Had we known Japan better, there might have been no Pearl Harbor. Had we understood well the problems of its farmers, China might not have embraced communism. Are we, through ignorance, now making just as tragic mistakes in south-east Asia?

You can help. If enough educators become stirred, it is likely that human geography will be given the important place it really deserves in the curricula of our schools.

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A number of sciences both natural and social are grouped together loosely under the heading of "geography." This is not astonishing in view of the fact that geography is the oldest of the sciences; in its early years, the study of any or all phenomena of the earth came under that name. An increase in the number of subjects included in the field developed with travel and the extension of knowledge of the earth in general.

However, a science of the various components of geography, uncovered by the development of knowledge of the earth and its inhabitants, could be advanced only by specialists who made separate studies of their own interests. There is a geographical aspect of all sciences which are concerned with the earth and its inhabitants, and some knowledge of these sciences is required of a geographer who deals adequately with his proper subject. Each science of geography has generally restricted itself to a certain subject matter which is an organized whole; the components of such subject matter are in many cases components of other wholes which are studied as separate sciences. There is, therefore, an unavoidable overlapping of fields.

Four main divisions of geography are generally recognized: mathematical, physical, biological, and human. These divisions are separate and distinct fields, although there seems to be some confusion—at least in the United States—about two of them, physical geography and human geography. For example, the idea of the relationship of life to natural environment is not within the scope of physical geography.

Physical geography studies physical phenomena, and treats specifically of their reaction on each other and of their distribution. In order to explain the reactions with which physical geography deals and their distribution, it must use the data of the sciences which study each element by itself. It keeps its own individuality by continually seeking to analyze the complex relationships between the elements, and to discover the causes of their geographical distribution. Physical geography has its own subdivisions, including climatology, meteorology, oceanography, and geomorphology.

The geomorphologist asks himself the question, "How has the surface of the earth come to be as it is?" He is devoted and dedicated to the analysis of land forms, and is, in methods of work, a geologist. Since the greater part of our topographic forms are inherited from the past, he must go back into geologic history to help solve his problems. On the other hand, the human geographer has often to go back into human history to help resolve the great questions which confront him.

Human geography is a study of the areal relationships of human societies. The human geographer concerns himself with how the people of such and such an area have come to be as they are because of the place where they live. He tries to answer the question, "How does the space it occupies with all its attributes (or resources) and their location affect a given society?"

In his series of investigations, the human geographer makes use of certain facts of geomorphology, climatology and other natural sciences. However, physical geography is only one of his bases. But the physical basis has taken, for so many years, such precedence in the United States, that *human* geography has been more diminished than exalted. It has often appeared merely in the role of a subsidiary volume, or simply a postscript.

There is for human geography, as for physical geography, a technique of research which must be guided by the problems presented in the nature of the subject. Since one field is in the physical sciences and the other in the social sciences, their methods of research have little, if anything, in common. In America, the geographic school has specialized largely in the evolution of the relief of the earth. Because human geography had its initial development in the United States under people trained in physical geography, it has been handicapped by that difficult alliance. One of the weaknesses of human geography, in its attempted development has been, for evident reasons of background and ease, the tendency to draw from the same sources as physical geography and natural history.

The human geographer must know the conditions of the natural environment, but not necessarily the origins of physical phenomena; in that way he is tied to physical geography and other natural sciences. Following that he must recognize the conditions of the human environment and, therefore, remain near the social science disciplines without which he cannot constitute the whole or the geographic environment. No true

scholar complains of the truth that science is not a shop with closed compartments. But from this double necessity of borrowing facts from two neighboring groups of sciences, human geography does not have uncertainty in its objective, part of which is how the trace of man on the earth gives us a clue to the conditions of his life, his way of living, his way of using land, and of occupying it.

The relationship between human geography and history is simply stated by saying that the former deals with space and the latter with time. Geography and history thus arrive at a knowledge of man, that is of human groups, in two different ways. History retraces the succession of ideas and of individual or collective decisions which have brought the human group to the circumstances where it finds itself. Its concept is generally of a psychological and political order. Human geography tries to understand the structure and the dynamism of the human group by considering the organizations and the activities inscribed or implanted by it on the extent of space which it occupies. History gives perspective to human geography. The past perpetuates itself by habits of thought which are crystallized in the facts of the surface, that is to say in the organization of the space which a human group occupies.

Economic and regional geography are two subdivisions of human geography which have received considerable attention, one in the United States and the other in France. The development of economic geography in this country is in considerable measure a consequence of the development of internal trade and commerce, and of an international trade in which America has played a considerable role. Nevertheless, this phase of human geography is sadly neglected in high schools in the United States, and the concepts are generally too advanced for pupils in the primary schools. Economic geography is generally only a beginning course for college freshmen who are specializing in a business education.

Regional geography has been developed in France, where scholars in human geography have excelled for many years. There, a close association between human geography and history is in part due to the scholarly leadership of Vidal de la Blache. Hellenist, archaeologist and historian, he helped the development of an approach emphasizing the past and the human factor more than the less fluid physical environment. Vidal's concepts, indelibly impressed on French geography, have preserved for it a broader outlook, and a better balance than, for example, its German contemporary.

In the United States, geography has not won full recognition in the curricula of schools and colleges. Its educational value in the training of modern men and women is not universally acknowledged. The public is largely ignorant of human geography and the press is in much the same state. During the few years that have elapsed since the end of World War II, we have seen the tragic,—perhaps we may say fatal—results of our ignorance of the outside world. A recent survey made by the *New York Times* shows the prevalent lack of understanding of the geography of the world and even of the geography of our own country. It shows that American and global geography have little standing in our educational institutions. The *Saturday Evening Post* corroborates the findings of the *New York Times*, referring to geography as, "the neglected subject in the school of democracy, a missed lesson for which we are always being taken to the woodshed by the dictators."

The reason for this is to be sought largely in the development of the United States. Up to World War I, the United States had developed for the most part in detachment from the rest of the world. The achievement of independence found the people owning a country from the Gulf of Mexico to the Great Lakes, excepting Florida, and as far west as the Mississippi River. The actual settlements, however, were, with a few minor exceptions, confined to a strip of territory along the Atlantic shore.

Piece by piece the Union was expanded westward, and it was just a hundred years ago that the Gadsden Purchase rounded out the states of Arizona and New Mexico. From the War of Independence, until the western borders of the United States touched the Pacific, and for several generations after its boundaries were established, the interests and energies of the new country were concentrated in filling up the great empty spaces with settlers from the East and millions of immigrants from European countries. The native sons were absorbed with the geography of the frontier, and the newcomers concentrated every effort in conquering a vast domain of prairie, forest, wilderness and desert.

During all this time, a good knowledge of world geography was not necessary for the well-being of the Republic. Our neighbors on the other side of the Atlantic were weeks away in point of time, and Asia, that is the inland parts of Asia, were months away. The European powers, even then experienced in international relations, were preoccupied with their own rivalries and ambitions, and, after England's break with her colonies, were glad to leave the New Republic alone. What restrained any potential enemy was the division of power within Europe itself. It was to the advantage of the European states to permit the United States to keep aloof from the power conflict in Europe.

Just now, an entirely new situation is confronting the United States. In place of a minor power that could be safely ignored in its chosen position of distant aloofness, it has developed into the strongest single power in the world and, more important still, has the responsibility for world leadership. Indeed, two things have recently made a knowledge of lands and peoples essential to the welfare of the American citizen. One is the shrinkage of the world in terms of time, and the other is the leadership of the United States in the small world of today. The airplane has, so to speak, reduced space to terms that are difficult to grasp. In July, 1953, an airforce "B 47" jet bomber flew from Maine to England in four hours and forty-five minutes. In terms of human geography every land and sea has undergone a sensational reduction in scale.

The problem of knowing world geography is furthermore intensified by the fact that never in a single

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Medical Technology for You?

● **By Sister M. Edwin, R.S.M.**
MEDICAL TECHNOLOGIST, MERCY HOSPITAL, PITTSBURGH, PENNSYLVANIA

This is another in the series of interesting articles dealing with unusual occupations that we have been publishing at intervals for some time. Others will appear in future numbers.

Not many people know what kind of person the professional technologist should be, the nature of the work he does, and its importance to the physician and the patient.

Here is excellent material for the student counselor.

●

Are you one of those people who have an interest in medical problems but have no desire to be with the sick? Would you like to use the microscope, the test tubes and the scientific equipment for laboratory tests that prove an indispensable aid to the physician in modern medicine? Would you like to choose a vitally important career in today's world—a career for which there is a great demand and too few to answer that demand? Then you should be interested in the profession of Medical Technology, the science of laboratory methods employed to assist the physician not only to find the cause of disease, but to prepare for and to check the results of the many newer drugs, treatments and techniques.

Medical technology is a comparatively new field. World War I proved its value, and it steadily advanced until World War II brought it to the very front rank in progressive medicine; but it is a field still too little known among those who want to choose a career of interest and of service.

A few examples will serve to illustrate the importance and the need of medical technologists:

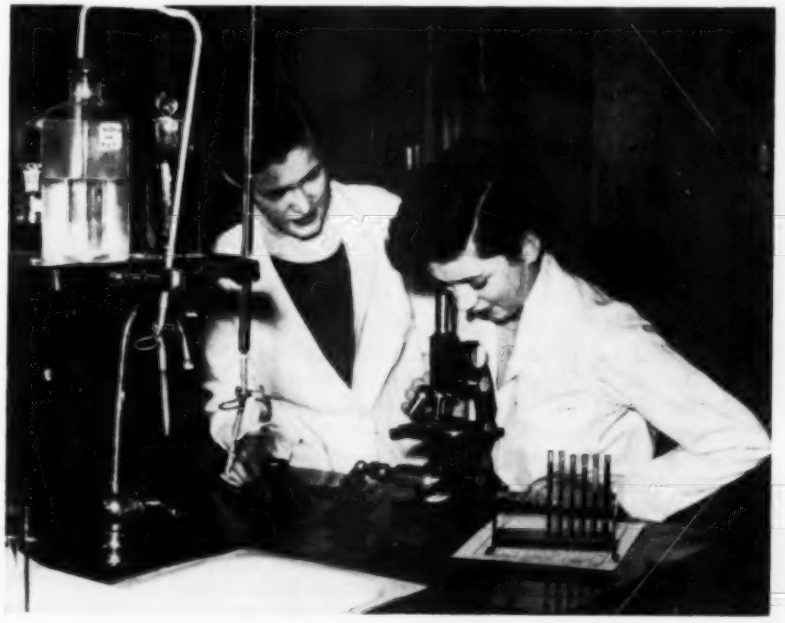
Richard, six years old, began to lose weight after his father died. His mother repeatedly took him to a physician over a period of six months. Each time she was told not to worry, since the child did not have a fever, was alert at school, and seemed normal otherwise. (This physician, like so many others, had not been able to procure a trained medical technologist.)

When a Social Service representative came to the home to find out what kind of mother the child had, and if she prepared proper meals, the mother became both worried and indignant and brought her boy to the hospital. Only then were laboratory tests done. The boy proved to be a severe diabetic, with cataracts beginning to form in his eyes. The concensus of medical opinion was that if the laboratory work had been further delayed, and if the true diagnosis had not been made until a few weeks later, the child would have died in diabetic coma.

One of the most common causes of a heart ailment in children is rheumatic fever. Newer laboratory tests prove that this complication can be avoided, or at least be made less severe, if the diagnosis is made early enough. Yet, we still see examples like the following:

Jean, an energetic, intelligent girl of fourteen years, developed a "cold." For weeks after the symptoms disappeared she remained listless, began to lose weight and to complain of aches and pains in her feet. She was taken to a chiropodist, who strapped her feet and ordered a pair of expensive corrective shoes. The condition, however, grew worse, and pains in the elbows and other joints caused distress. Finally, laboratory tests were ordered and the diagnosis of rheumatic fever made. But it was too late!—extensive heart damage had already occurred. How different the future of that child would have been had the correct diagnosis been made when the first symptoms of complication appeared.

To turn to the joyful side of the picture, take this case: An only child, a beautiful girl, seventeen years old, was diagnosed as having lymphatic leukemia. She was sent to the hospital for deep X-ray therapy. The parents, knowing the prognosis of leukemia is not good, were deeply grieved. However, before the treat-



Medical Technologists at Work

ments were begun, the medical technologist was asked to run any test that might confirm or disprove the diagnosis. She found that while the appearance of the blood cells seemed to confirm it, a blood serum test, called the heterophile antibody or Paul Bunnell test, definitely and completely disproved it. The physician then diagnosed the case as infectious mononucleosis, which is never fatal. When he gave this good news to the parents, their unbounded joy made everyone grateful to the man who originally spent many hours in research before discovering this test that is now done frequently by medical technologists.

Have you ever stopped to think how necessary are blood transfusions in cases of severe wounds, shock and hemorrhage? Without the blood typing tests performed in the laboratory, blood transfusions could be the cause of death. Accurate blood typing tests are also of great importance in lessening the mortality rate of mothers and babies.

Our final illustration concerns a man who had had a heart attack. The laboratory was asked to do a white blood cell count, a blood sedimentation rate, and an electrocardiogram. The results of these tests, plus the clinical findings of the physician, prompted him to diagnose the condition as "coronary occlusion" caused by a blood clot. The medication "Dicumarol" was ordered as a means of retarding intravascular clotting, for clots once formed can grow rapidly enough to prove fatal; but this medication could be extremely dangerous. If too much is given, the blood gradually loses its power to clot, and the patient may bleed to death. To keep a perfect balance and avoid all danger, the laboratory personnel did a prothrombin test each day until the patient recovered. Think how much more hopeful and bright is his future now than in former years when such a patient had little chance of survival, or had to lie in bed sometimes for a year or more before the blood vessels could form a new branch to re-route the blood flow. He then seldom resumed a normal way of life.

There are numerous examples that might be given to illustrate the variety of medical problems that of necessity require the vital aid of medical technologists, but these few will suffice to show why physicians and surgeons are now seeking their services to a greater extent than ever before. The man or woman in this career is truly in the front rank of the crusade against disease, suffering, and early death. Does it appeal to you? If so, then you will want to know what preparation and training are required.

The standards of the American Society of Clinical Pathologists, as outlined by the Registry of Medical Technologists, require the applicant to have at least sixty semester hours of college work. These must include twelve semester hours of biology taken from among the following: general biology, genetics, bacteriology, histology, parasitology, zoology, and anatomy or embryology. The applicant must also have at least six semester hours of inorganic chemistry, and three semester-hours of either quantitative analysis, organic chemistry, or biochemistry. Both bacteriology and quantitative analysis are highly recommended. Physics, typing and mathematics will prove helpful. Although the national standards specify a minimum of sixty semester hours of college, many schools of medical technology require three years of college; some require a college degree.

After the college work, the technical training consists of a one year course in a hospital which has an approved school of medical technology. Throughout the course, the study of scientific principles is consistently integrated with practice in hematology, urine analysis, parasitology, bacteriology, serology, biochemistry, histology, parenteral therapy, and miscellaneous tests such as basal metabolism rates and electrocardiograms.

The personal training includes the elimination of such faults as gossiping, careless technique, and "jumping to conclusions"—conclusions not warranted because of incomplete data. As in any profession, it is character as well as aptitude which makes for true success. The ideal characteristics which make a really distinctive medical technologist include:

1—Honesty, moral and intellectual integrity;

2—A questioning mind, alert to find ways and means of greater knowledge and greater accuracy;

3—Keen interest in scientific work and in the sick, an interest genuine enough to offset the monotony of routine;

4—Pains-taking enthusiasm that enables one to acquire skillful finger dexterity, accuracy, efficiency and judgment;

5—Cheerful generosity from which springs a friendly spirit of cooperation;

6—Patience that does not permit one to become easily discouraged, since discouragement produces indolence, indifference and carelessness;

7—A knowledge of the value of criticism, that it may be used as a stimulus to such achievement as places one beyond or above it;

8—A fine sense of responsibility;

9—Avoidance of the expressions "I can't"; "I don't want to"; "I don't like";

10—Cleanliness.

Since medical technologists are human, many may not possess all these qualifications and yet be very valuable to the physician. The laboratory has been called the vital "pulse" of the hospital, and the heart of the laboratory is the medical technologist. It is an interesting life that always provides a challenge to mind and heart. It is always a life of service.

IS MEDICAL TECHNOLOGY FOR YOU? ●

★ ★ ★ ★ ★

The progress of the pure science, of the theoretical science, of the science which deals with a search for principles rather than a search for applications, is the progress of natural philosophy. It is the gradual unfolding of our comprehension of the material and energetic components of our universe.

—PAUL A. MEGLITSCH
Drake University

The Need for an Alternative Course for Solid Geometry

● **By Sister M. Michael, R.S.M.**
DEPARTMENT OF MATHEMATICS, MOUNT MERCY COLLEGE, PITTSBURGH, PENNSYLVANIA

This plea for a substitute course for Solid Geometry in high school deserves very careful consideration.

The mathematical preparation of high school graduates has long been subject to criticism, and not without reason. Some of the material they are expected to master may be of little service in later life. Here is a proposal for a modification of the usual mathematics program that can easily be made. It will serve well the needs of many students.

Your comments will interest the writer.

●

In this paper I do not wish to convey the idea that Solid Geometry is a useless course. It has a very definite place in the program, but for most of us we must choose between that course and other courses which will more adequately meet the needs of our pupils. To show that a choice is necessary, let me propose three questions concerning the mathematics curriculum of today, 1954.

1. Where are we?
2. Where do we want to go?
3. How shall we get there?

As to the first question—Where are we? If we recall the development of the secondary school we find that so far as content is concerned we have added much to the subjects taught in the first Boston Latin School, or even in the later Public Academy. We have added new subjects without eliminating any of the original subjects, until now we have an overburdened curriculum with the additional hardship of less time.

During the past century our student body has changed considerably both in number and purpose. The enrollment has increased until, at the present time, more than seventy per cent of the youth of America avail themselves of an education beyond that of grammar school. With this increase in number it is natural that there should be many, in fact according to recent survey the greater part, who will terminate their formal education with the twelfth grade, through either necessity or desire.

The capabilities and interests of this group have likewise become much different. The early student was a member of a selected group preparing only for the ministry or professional fields with every intention of continuing his studies. Today, the high school is not only open to all American youth, but obligatory to many. Therefore a variety of abilities and interests will be evident. Thus we find ourselves today trying to teach the same subjects, plus many more, to a large group of students who have not the same attitudes nor goals as those for whom the subjects were first planned.

As to the question—Where do we want to go? No better answer could be given to this than to state the aims of education as expressed by leaders in the field. From the encyclical of Pope Pius XI we have ". . . education consists essentially in preparing man for what he must be and for what he must do here below, in order to attain the sublime end for which he was created."

The Harvard Committee of Twelve on the objectives of a General Education in a Free Society states the outcomes as the ability to think effectively, to communicate thought, to make relevant judgments, and to discriminate among values. And, finally, " . . . the development of an intelligent person, one who is able to analyze problems, to think them through clearly and to bring to bear on them a wide variety of information, who understands and cherishes significant and desirable social and personal values; who can formulate and carry out a plan of action in the light of his knowledge and values is an adequate end for education of a competent citizenry."

These are all general aims, but we can summarize them and parallel them with the aims of secondary education in mathematics as formulated by the National Committee: "The primary purposes of the teaching of mathematics should be to develop those powers of understanding and analyzing relations of quantity and space which are necessary to an insight into and a control over our environment and to an appreciation of the progress of civilization in its various aspects, and to develop those habits of thought and of action which will make these powers effective in the life of the individual."

We know, then, where we want to go. We would like to give the pupils of our high schools, especially in their last two years, a variety of courses which would provide mathematical opportunities for all in accordance with individual needs, abilities and capacities. This gives rise to the third question—How shall we get there?

The National Committee for the Reorganization of Mathematics has given us much help in presenting a program for the first ten grades which will to a large extent provide those utilitarian values that are of fundamental and universal importance—such as the indispensable skills of the operations of numbers, the interpretation of graphical representations, analysis and the application of algebraic formulae, the elemental spatial relationship, and the common mensuration and geometric configurations. Thus, if a student has

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Personality Factors in Human Relations

● By **A. T. Oliva, Ed.D.,** *(Columbia University)*
DEPARTMENT OF PSYCHOLOGY, DUQUESNE UNIVERSITY, PITTSBURGH, PENNSYLVANIA

This thoughtful paper contains much sound good sense. You will think about some of the ideas here expressed long after you have forgotten where you read the article, and who wrote it.

Do you agree that mental conflict provides an opportunity for development? Is it difficult to be a person of intellectual integrity? Would you define civilization as man's effort to grow away from his original state of brutal separateness, of indifference? How does one become a genuinely mature person?

●

Everywhere, today, we hear the terms human relations, human interaction, and group dynamics. Now, I am afraid that some of these concepts may through mechanical repetition and habituation become nothing more than sterile verbalizations. Like the Lord's Prayer, many repeat it; few practice its spirit.

We must always keep in mind that any consideration of the question of human relations must begin with the heart of the matter; and that is the individual personality as the central pivotal factor. Without the individual there would be no human relations. Psychologically speaking, then, human relation implies a unity of interacting personalities. Nor may we discuss this unity without reference to its social context for this interaction takes place within a particular culture pattern with its predominant interests and values and its galaxy of institutional pressures.

So, let us inquire what are the personality factors operating within a culture matrix, that enter into human relations.

It seems to me that when all is said, our deliberation crystallizes into four pivotal ideas, namely:

1) Self understanding
2) Intellectual integrity
3) Empathy
4) The cultivation of the sense of human relatedness.

First, let us take up the idea of self-understanding. By this we mean insight into one's own motivation, one's needs, interests, aspirations, prejudices, weaknesses, and strengths. It means the courage to be objective about one's self.

An individual without any understanding of his own personality is in a sense a "captive"—he is at the mercy of the many complex forces impelling him to behave in a variety of ways frequently inexplicable to himself. He may experience anxiety without any apparent cause; he may know terror without motive; and, finally, he may even sever all connections with reality through a flight into psychoses.

We hear the term "frustration" used frequently. I wish to relate this concept to self-understanding. It is an incontrovertible fact of life that a certain amount of frustration is indigenous to the living experience. Yet, this obvious phenomenon frequently eludes the most thoughtful. When frustration is not understood and acted upon with intelligence, we find the following characteristic responses: moodiness, anxiety, phantasy, hostility, aggression, nervous symptoms, etc. It is not enough to have knowledge or insight. What is equally important is the "will" of the individual toward modifying his undesirable motivations and irrational attitudes and predispositions.

It is also true that everyone experiences mental conflict of some kind and in some degree. These conflicts are likely to precipitate such responses as fear, confusion, and anxiety, and feelings of remorse, guilt, and uncertainty. Strange as it may seem, however, mental conflict provides an opportunity for development. If the mental conflict is solved by an objective attitude we have a condition for growth and the development of a wholesome personality.

The pressures of modern living, the presence of competition and the rivalries in our society are so numerous that the most stable persons are bound to experience mental stress and disappointment. The threat, for example, to one's professional status and security is so strong and recurrent that I need not elaborate its implications here. I repeat, it is important that we actively understand the many predisposing factors in individual behavior lest we identify mental conflict exclusively with the inept and the potentially psychotic.

The late Dr. Karen Horney, brilliant psychoanalyst, has well illustrated in her writings the hiatus that exists in our society between the world of values and the world of material conquest. Sensitive individuals motivated by loyalty, devotion to principle, and integrity of purpose, will frequently experience the malaise that often accompanies the best of creative effort.

Let us consider the second key idea—intellectual integrity. Many years ago St. Thomas wrote in effect "The intellect strives for truth but is subject to error." This was, indeed, a perceptive observation. We know of the human predilection for error. How quickly have we been diverted from the path of truth as a result of personal bias, self-interest and outright ignorance. Psychologists tell us that a considerable portion of our thinking may be described as autistic, *i.e.* fantasy elaboration or dereistic thinking, meaning that our thought may be without relevance to objective fact and reality. Rationalization is the mental process of devising ostensible reasons to justify an act or opinion which is based in other motives, although this may not be apparent to the rationalizer.

We must bear in mind that there is always an ego involvement in human thought, and, therefore, it is not easy to be a person of intellectual integrity. By intellectual integrity we mean the process through which one becomes an increasingly rational and re-

flective person. From our special viewpoint this implies a professional objectivity and scholarly interest in one's specialization. This integrity requires that the individual abide by the ethical imperatives of his calling. Surely our minds must have perspectives beyond our immediate professional orientation. We must think about and become concerned with the larger issues of our culture, for our meaningful identifications extend very considerably beyond the purview of vocational adjustment. We are, after all, members of a great society.

The third pivotal concept is empathy. Empathy is a mental state in which one identifies or feels himself in the state of mind of another person or group. We must strive to become increasingly emphathetic. This is not easily attained. Like intellectual integrity, it is an emergent, the outcome of deliberate conscious and practiced orientation toward our fellow beings. The noted philosopher and humanist, Henry Alonzo Myers, once wrote "On the level of the human spirit an understanding heart is one that can share a man's point of view. Friends, companions, lovers are those who treat us in terms of our unlimited worth to ourselves. They are the closest to us who best understand what life means to us in triumph and disaster, who break the spell of our loneliness."

And, finally, the last of our central ideas, is the cultivation of the sense of human relatedness. This means the recognition that we share in common our fundamental human needs. We all require love, recognition, acceptance and security.

George Bernard Shaw once remarked "The worst sin toward our fellow creatures is not to hate them but to be indifferent to them. That is the essence of inhumanity." Of course we cannot love all our fellow men except in the most abstract way. But we can at least be sympathetic and charitable toward them.

Harry Stack Sullivan, the late distinguished American psychiatrist, once characterized our era as an age of unrelatedness. "Ours," he said, is "a schizoid age in which despite all our so called contacts people often remain strangers to each other."

I ask you: What is civilization, after all?

Surely, it is man's effort to grow away from his original state of brutal separateness, of indifference. H. G. Wells was deeply aware of this when he wrote:

> "I am possessed with the overwhelming desire to find out all about the people with whom I am brought into juxtaposition, to commune with their hearts and search out their tastes, their ambitions, their circumstances, their purposes, their prejudices, their reasons, and their dreams. I desire to compare my own experiences and aims with theirs, to establish connecting doors in our respective minds."

The sense of connection is like a muscle. Unused it withers; exercised it grows. Let us pursue Clifton Fadiman's suggestion to

> "Look at the next strange face you see, in a train, a theater lobby, behind a counter, but really look at it. Behind those eyes there is a whole life, as complicated, as mysterious as your own. If for only a fleeting instant, you can feel the pressure of that life, you have hailed in passing that unique miracle—the other fellow."

You may have observed that I have not mentioned the term maturity. It is evident, I think, that the foregoing remarks are clearly related to the maturation process. But I would like to explore the question of maturity further, for human relations will be creative only in direct proportion to the maturity of its constituents.

Life has opened up new dimensions of responsibility for us. We have been prosperous and inventive and resourceful. But the irony of our current situation is that we continually trust the *techniques* or *know-how* of our adjustments when actually the unique challenge that confronts us is one of ultimate loyalties and faiths, value choices, and the utilization of spiritual resources. It is only through the cultivation of these functions that one may be said to emerge a genuinely mature person.

I trust you will not object to my momentary excursion into the realm of philosophy for there is a unity in human purpose and the psychologist is compelled to ask the fundamental question.

The mature person has discovered some of life's meaning and goal. Our own religious tradition finds the most helpful clue to the understanding of life's mysteries in a Will and Purpose and Mind behind all things, which we designate as God.

It is regrettable that the naturalistic orientation of so many psychologists makes them incapable of understanding the role of religious motivation in the integration of personality. For example, they cannot understand fear in its religious context. Fear, they explain is fundamentally a primitive reaction which occurs when an individual has not developed a technique of adjustment in regard to a given problem. While we all recognize the general validity of this concept, we hold that such is not always the case. We say that fear may be quite rational. The fear of God is not an atavistic residue, for it implies the reverent and awesome recognition of the reality and sovereignity and power of God and the accountability to him for our freely determined acts.

It is paradoxical that so many intellectuals who claim to be liberal, cling passionately to their own narrow system of meaning.

The science and art of human relations will gather in scope and momentum as we reach out in our search for wisdom. We know this quest will be an endless one, sometimes fraught with human disillusion. But we are equally cognizant of its rewards, for in the enrichment of our spiritual life we give substance and meaning to the enormous possibilities for human interaction. In our supreme affirmations we stand revealed before everyone.

Were we to make these key ideas functional aspects of our own behaviour, we would have the great satisfaction of knowing that our lives are well spent. We might never attain the pinnacle of professional success. Few people are so gifted. But we would have the greater satisfaction which comes from being a fundamentally decent person. What more may justly be asked of anyone? ●

An Elementary Science Project -- A Frieze

• By **Peter Vroom, B.S. in Ed.,** *(New Jersey State Teachers College, Trenton)*
HIBERNIA GRAMMAR SCHOOL, HIBERNIA, ROCKAWAY TOWNSHIP, NEW JERSEY

Even very simple studies in elementary science may stir great interest among pupils and their parents, especially when groups of students work together at a common task.

Here is a story of an easily reproducible project planned and executed under the direction of an enthusiastic young teacher who not long ago was making use of his knowledge of science as a Radio Technician on one of Uncle Sam's submarine chasers.

The enthusiasm he engendered in his pupils is evident from their comments.

●

The teaching of science in the elementary schools of Rockaway Township, New Jersey, is a comparatively new activity, but it has already proved itself. Introduced some five or six years ago in the school in which I now teach, it soon demonstrated its interest and value, and science became a part of the course of study of the other elementary schools of the Township.

The teaching of science in a small, rural, elementary school presents special problems, but we have found that, in one way or another, usually they can be solved. The location of such a school has advantages, too, in the study of certain phases of biology. Regardless of the location of the school, a good textbook, sufficient visual and auditory aids, support by the administration, and interested pupils, parents and teachers, can bring success.

The text we are using is *How and Why Discoveries* from the "Scientific Living Series" by Frasier, MacCracken, Decker and McNaughton. To supplement it, we use television, films, slides, newspapers, magazines, weather reports, home-made apparatus, and other teaching aids.

Our pupils, like pupils everywhere, like to do things and make things. We have built weather stations near the school and have charted temperatures for several months at a time. The pupils attempted to make weather forecasts. We made a barometer using a milk carton and other waste materials, and found its readings not too inaccurate when compared with a real barometer. Many other projects were attempted with greater or less success. One of them, the making of a science frieze, created a great deal of pupil interest and resulted in a colored decoration that was worthy of preservation.

MR. PETER VROOM and his

The frieze, show-

ing various forms of plant and animal life in and around a pond, was executed, from planning to completion, through the cooperative efforts of all the members of the sixth-grade class.

The plan was conceived as an outgrowth of our text's unit on pond life. We asked the class to select a project which would be an aid in remembering the forms of life found in the three zones of a pond. Their unanimous choice was to make a frieze and, for good measure, they decided to add a fourth zone—the land zone—to those being studied.

This meant that the frieze would be presented in four panels representing each of the four zones: land, reed, water-lily, and open-water.

M and his embryo scientists.

After several planning sessions the class decided on the following points:

The medium would be pastel chalks. (Crayon and paint were too difficult to alter after an accident.)

The pond with its shore line and bottom would be depicted in a cross section, as if sliced down by a giant carving knife.

A space one yard long on yard-wide paper would be allotted to each zone.

The class would divide into committees, according to interest, to work in each zone.

The names of plants and animals for each zone would be listed by the committees, so that individual members could select an equal share to draw.

The scale would be life-size.

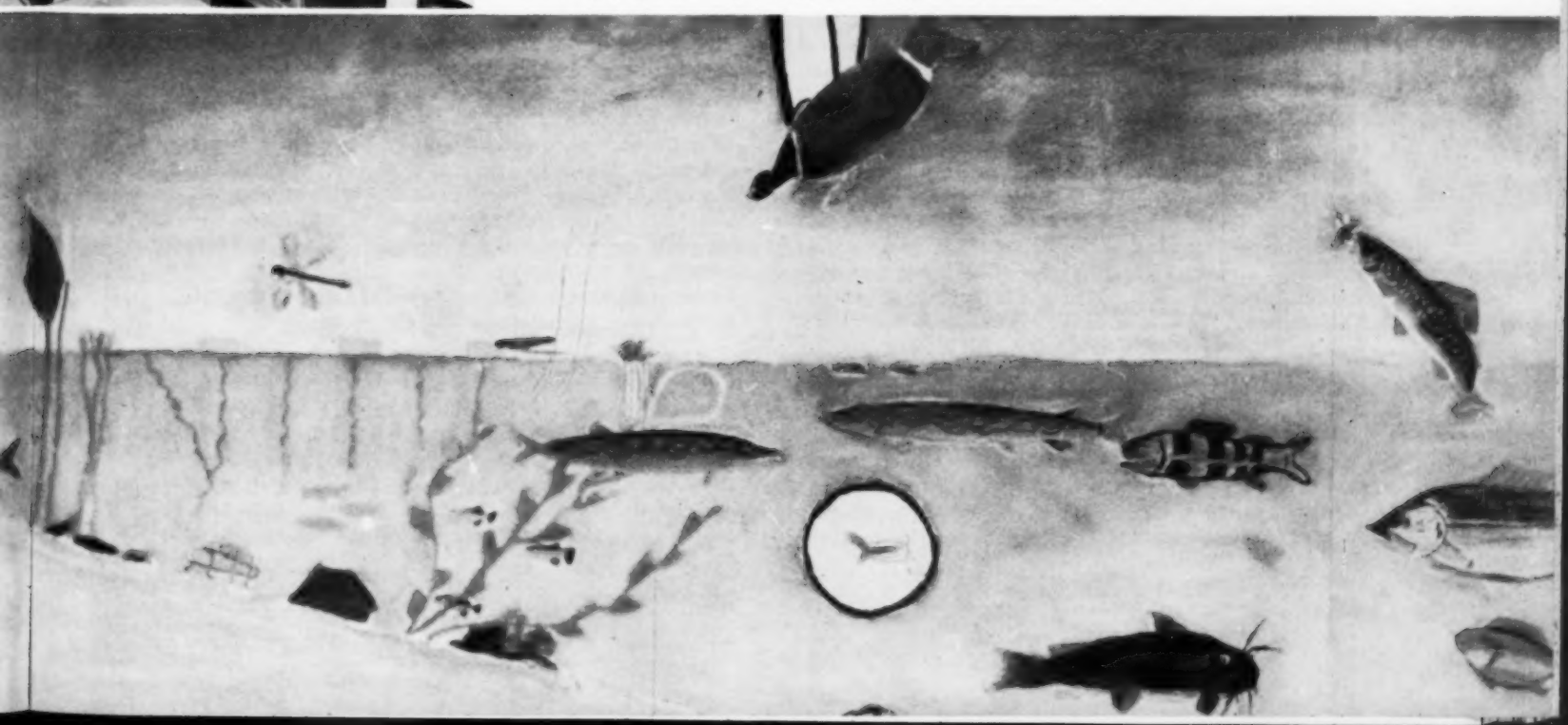
Most of the pupil research was devoted to finding the correct size and coloration of the forms of life to be drawn. For this, pupils studied the actual plant or animal if it could be found. They used *The World Book*, some classroom science reference works, and books and magazines from home. *The Winston Dictionary for Schools* was especially helpful for finding correct sizes of animals.

Work on the frieze started with each zone's members making a small sketch of its panel, showing the waterline and slope of the bottom. In it were drawn the forms of life found in the zone. On the reverse side of each pupil's diagram was made a full size drawing of one of the forms of life for which that pupil was to be responsible. It was colored with pastels for practice in the medium. Separate abstract pastels had previously been made by each pupil for practice in applying and blending the colors.

Next, a twelve-foot section of thirty-six inch frieze paper was attached to a chalkboard and blocked off into one-yard panels representing the zones. The water line, land surface, and bottom were sketched in. Then work was started on sketching in various forms of life found in and around the pond. It was found best to limit to two the number of pupils working in any zone

(Continued on Page 38)

FRIEZE (below) made by Sixth Grade Pupils of Hibernia Grammar School, Rockaway Township, New Jersey. In the *Land Zone* are: swallow, snail, turtle, turtle eggs. In the *Reed Zone*: marsh grass, frog, frog eggs, cattails, red-winged blackbird, burr reed, caddis fly in various stages, dragon fly, spotted turtle, water plantain, pickerel weed, arrowhead, fingernail clams, sucker. In the *Water Lily Zone*: water plantain, pond weed, mussels, painted turtle, water lilies, minnows, damsel flies, snails, stickelbacks, worms, crayfish, elodea, pickerel, duck weed, algae. In the *Open-Water Zone*: snapping turtle, cyclops (seen through a microscope), pickerel, faily shrimp, catfish, perch, trout, bass, sunfish, and duck.



Out of Doors

● By Comly B. Shoemaker
NATURALIST, FRICK PARK, PITTSBURGH, PENNSYLVANIA

You will be interested in these modest "short stories" about an outdoor recreation that gives pleasure to thousands of lovers of nature. The activity requires no great physical exertion on the part of the participant, and no large amount of complicated apparatus or materials.

It will be evident to the reader that the writer, who is a Park Naturalist, is not only a keen observer but also a man who really enjoys his work.

●

Bird Watching

The portrayal of outdoor pleasures is beautifully told in Longfellow's poem, which reveals the enthusiastic desire of Hiawatha to:

"Learn of every bird its language,
Learn their names and all their secrets,
How they built their nests in summer,
Where they hid themselves in winter."

An interest like this is the basis of a very delightful hobby—bird watching. Many agree with me that it is an ideal form of recreation to free the mind of cobwebs. It gives relief from life's daily strifes and contentions, and produces peace of mind. It will bring much pleasure to one wandering wherever whim or fancy dictates on any day of the year, and in any place that offers great appeal or convenience.

Some may think that the best place to watch birds is far afield. Fortunately, this is not the case. A considerable number of birds visit our city parks, more than most people imagine. You may be surprised to learn that in the past twelve years, I have observed a total of 125 species in Frick Park, Pittsburgh, and that my yearly record has been close to 100 species. Probably many others visited the Park, but this gives an idea as to the number one may expect to see. If the area is enlarged to fifty miles around Pittsburgh, as the Audubon Society does each year, one may equal their list of 163. Even this total can be increased to perhaps 200 by visiting the Pymatuning area. A few years ago, a group of Audubon members spent two days around Linesville, Pa., during the spring migration. They reported 144 species as their combined observations. This was a very good number for such a short period.

Possibly you are not interested in seeing large numbers of birds. You may prefer listening to fascinating bird songs or just watching the flashes of color flitting from branch to branch. Possibly weird courtship performances may attract your interest, and lead you to a close study of bird behavior around the nest. Seat yourself at a distance, far enough from the nest not to disturb the parent birds. Witness the tender care of the young, and see the immense quantity of food required by the growing babies. In most cases, they will consume their own weight in food each day. When this food is small insects, you can appreciate the tremendous number destroyed. This is an extremely valuable service in protecting plant life, to say nothing about our own comfort.

There is one important precaution to be taken around a bird's nest: never tramp a trail to the nest or handle the eggs. If you do, it will probably attract predators and may cause the destruction of the nest. Sometimes nests are placed near your home, on a window sill or some odd place, giving a splendid opportunity to watch the family life, if it is not disturbed by cats. Any unusual nesting place is always interesting, especially to bird photographers, who are particularly anxious to photograph such scenes for educational purposes.

Hummingbird

To the deep tubular throat of the Weigelia, comes a darting, pulsating mite,—its scarlet throat and emerald-green back glistening in the sun's rays. It is here, it is gone, it is back again—the ruby-throated hummingbird. It remains suspended in mid air, while partaking of the flower's nectar. All this time, the wings are beating so rapidly they are almost invisible. The bird actually flies backward, and then hurries away to explore other flowers. At last it comes to rest on a nearby perch. This surprises many people, because it is a common belief that the ruby-throated hummingbird spends most of its time on the wing. The truth is, it spends a lot of time at rest. At such times, this tiny bird is quite hard to see.

Carl Schlag of Pittsburgh, a member of the Audubon Society, has made a close study of the hummingbird for several years. He looks for the first arrivals very shortly after May 1st. The males precede the females by a few days. Soon there—they begin their amazing courtship. While the female is at rest, the male performs his unique "pendulum flight," swinging back and forth with great rapidity, as if suspended by an invisible string, displaying the rich sheen of his throat gorget, as he twitters continuously. Yes, the ruby-throat does have a squeaky note but it is very effective in charming an admiring female.

Nest building usually begins about June 1st, with the female doing all the work. The structure is a masterpiece of fine plant-down, with the outside completely covered with a stucco of bluish-gray lichens, making the neat cup-shaped nest appear like a knot on the branch. At the end of two weeks the beautiful nest is completed, and two tiny white eggs, the size of navy beans, are added. The next two weeks the mother bird

has to stay at home, to keep the eggs warm, leaving for only short periods of time to hunt for food.

When the young are first hatched, they require considerable brooding and little food, but as they grow, this procedure is reversed and the mother is kept busy hunting for very small insects and flower nectar. The feeding is by regurgitation, a rather frightful sword swallowing act, but the babies don't seem to mind. The young birds remain in the nest for three weeks and then are able to leave. They are immediately at home on the wing.

Carl Schlag reports that the hummingbird is curiously fearless. It is fairly easy to entice them to feed on sugar syrup, contained in a small vial attached to a stick about six inches long, and held in the hand. This is a neat trick and quite a thrill, if you have patience and remain perfectly still. The least sudden motion will scare the bird away. In September, these birds leave for their winter home in South America.

A Thrilling Experience

Did you ever experience the thrill of having eight gorgeous cock pheasants parade before you?

I wish you could have been with me in the middle of January, when it was my great pleasure to have these beautiful birds pose before my camera. This is how it happened. It was on one of those extremely rare winter days when the cloudless sky was a brilliant blue. As it was quite cold, my automobile was to serve as protection from the wind and also to act as a blind, from which to operate the camera. The car was therefore placed near one of our Frick Park feeding stations where scratch feed had been placed on the ground to attract the birds into the open.

After patiently waiting for some time, a flock of cardinals appeared. Twelve of them perched on a low bush, fairly close together, and in full view. Ten others flew to the ground and started feeding. The crimson plumage of the males, glistening in the bright sunlight, made a beautiful picture. Their mates, in delicate olive-brown garb displayed a charming personality that we enjoy.

The picture changed quickly when two magnificent ring-necked pheasants came strutting toward the feeding station. They moved cautiously, continually watching my car to make sure it was safe to approach closer. Most birds do not seem to mind a standing car, but with the slightest movement they are gone. Sometimes the noise of a camera will disturb them, and that was what happened this time. Looking to the left, I saw six more cock pheasants hunting weed seeds. Gradually they worked closer, and one by one they came into photographic position. As they moved away, I noticed that two of the pheasants had a disagreement and were staging a sparring match. Unfortunately they were concealed by the bushes and it was impossible to take pictures of the fight. There were no females present at this time.

While the eight pheasants were performing before my camera, I noticed a small covey of bobwhite entering the area about 100 feet away. They fed in the tall weeds for a short time, and then settled down for a rest. After waiting for a half hour, one of them started walking very slowly toward me. The others followed lazily, giving the impression that they would soon be in photographic range. But, no! After coming twenty-five feet nearer, they again settled down for a nap. I was beginning to think that they would never come close enough for me to take their picture.

After another long wait, one bobwhite started moving very slowly towards the scratch feed I had placed on the ground. The others followed, and finally four of them lined up, wing to wing, facing me. This was the moment I had been waiting for. My movie camera was started and I ran it all the time the two males and two females were feeding. When they were finished, they strolled up a bank and entered a deserted ground hog's hole, a protection which these birds sometimes use in bad weather.

The birds moved away, but the memories of the day will linger for a long time.

Winter Feeding

The care and protection of wild creatures during winter, when the ground is covered with snow and ice and when food is scarce and hard to find, pays big dividends in satisfaction and enjoyment.

To prove this, try walking through Frick Park with some peanuts or sunflower seeds, and from time to time stop and give several whistles. They need not have any resemblance to a bird call, but they will be effective in attracting attention.

Very soon a Titmouse, Chicadee, Cardinal or Nuthatch will appear. When the food is seen, these birds immediately announce their find by chirping their call of "come and get it." This is an unselfish characteristic humans would do well to copy.

Better yet, erect a feeding stand near your home where you can watch it from a window. It should be supported on an iron pole about six feet high, thus making it squirrel proof. If it is placed among low shrubs, the birds will enjoy it more. This cafeteria should be started in late Fall when the weed seeds begin to get scarce and before the snow covers the ground. The birds will then know where they can find their daily food. The first day you put out scratch feed, very few birds will be seen accepting your offering, but you will be surprised to find how rapidly the word is passed around, eventually resulting in a capacity attendance at your banquet table.

It is interesting to watch the different species at a feeding station as they select the particular seeds they like best. The need for a variety of grains is plain. The behavior of the birds is fascinating. The Cardinals feed on the ground in close proximity to each other in complete harmony; but on the feeding stand only one is allowed at a time, with the exception that occasionally there will be one Cardinal on either side of the table. The male rarely permits a female to eat

(Continued on Page 31)

NEW BOOKS

Elementary Quantitative Analysis

• *By* R. L. VAN PEURSEM, and H. C. IMES. New York: McGraw-Hill. 1953. Pp. XIII + 383. $4.50.

The choice of subject matter in this textbook was based on a study of the courses given in several hundred institutions throughout the nation. All the topics found in at least 20 per cent of the courses surveyed are included. Only 10 per cent of the courses surveyed included the use of instruments other than pH meters and colorimeters; consequently instrumentation has not been developed. Since more and more analytical procedures take advantage of instruments, and since in quantitative analysis the student is subjected to colorimetry and to potentiometric titrations, he should at least be aware of spectrophotometry, conductometric titrations, and other similar useful analytical methods.

The book is divided into four sections. The first deals with the principles and theoretical aspects of quantitative analysis. Calculations, precision, and accuracy are adequately discussed in the second section. Section three presents an excellent selection of laboratory experiments, while the last section deals with laboratory techniques. Some users may question the desirability of presenting laboratory techniques after the laboratory exercises, since the student is constantly referred to the techniques section.

The information in this text is well organized and well presented. The book can be used for either a one-semester or a two-semester course. It is designed for both chemistry and non-chemistry majors. We recommend it for use in a beginning course in quantitative analysis. The price is moderate.

Martin Blake, Ph.D.
Department of Pharmaceutical Chemistry
Duquesne University

The Suez Canal in World Affairs

• *By* HUGH J. SCHONEFIELD. New York: Philosophical Library. 1953. Pp. X + 174. $4.50.

The Suez Canal and the controversy concerning it are now so much in the world news that this authoritative book of modest size is a welcome addition to the book shelf. It is the latest of the author's three volumes on the Canal and its founder, and one of a score of books dealing with this geographical area that he has written. It is the latest word on the subject from the British point of view.

Starting with the time of the Pharaohs the story of man's attempt to join the Mediterranean and the Red Seas by a navigable waterway unfolds in vivid detail. There is much about world politics as well as world history. The difficulties experienced by deLesseps are explained at length, the defense of the Canal in both World Wars is outlined and the present Anglo-Egyptian disagreement is discussed.

H. C. M.

Comparative Embryology of the Vertebrates

• *By* OLIN E. NELSEN. New York: The Blakiston Company, Inc. 1953. Pp. XXIII + 982. $8.00.

This textbook of vertebrate embryology is decidedly a new approach to the subject. The approach is a broad, comprehensive one, which the author believes to be a fundamental requirement for the furtherance of biological research. To assist in comprehension, he endeavors to correlate embryology with adult anatomy. This difficult task is thoroughly executed. It does not reflect the confusion which usually results from such an undertaking.

The book is divided into five main parts. Part One is concerned with the relationship of testis and ovary to reproduction and to meiosis. The author allows over 170 pages for the coverage of this, "The Period of Preparation." This is but a slight indication of its thoroughness and extent.

Part Two, or the "Period of Fertilization," contains 100 pages of a well documented account of gamete transportation and fertilization. This section, as well as the entire book, is well illustrated with drawings and charts which should prove to be an asset to the student.

The early embryology and basic features of morphogenesis in the vertebrates are considered in Part Three. Especially noticeable are the excellent account and comparison of the complex process of gastrulation.

Part Four, well over 300 pages, is an account of the development and comparative anatomy of the organ systems. All the major systems are considered. A chapter on the development of the endocrine glands and their relationship with development in general is included.

The last section gives a final touch to this comprehensive textbook with an orderly treatment of what the author calls, "The Care and Nourishment of the Developing Young."

The chapter outlines, numerous illustrations and extensive bibliography should popularize the book among students, especially those at the graduate level.

R. O. Heckerman, M.S.
Department of Biology
Duquesne University

Ionic Processes in Solution

• *By* RONALD W. GURNEY. New York: McGraw-Hill Book Company, Inc. 1953. Pp. 275. $6.50.

This book deals with the chemistry of ions in solution (as distinguished from the physics of ions in gases), and is primarily addressed to students and research workers in the field of electrochemistry.

The first six chapters of the book set forth the fundamental ideas and principles on which an interpretation of ions in solution can be based, and present the interrelationship among electrochemistry, thermodynamics, statistical mechanics, electrostatics and molecular physics. A criticism of this part of the book is that the author coins too many new terms, for example, D,L,Y,J. These terms are not in general use and moreover refer to one common idea, namely dissociative energy, so that the introduction of these separate terms leads only to confusion rather than to clarity.

Chapters 7 to 16 of the book deal with experimental data. Here the author successfully applies his unified interpretation of ionic behavior to a wide variety of results, such as, autoprotolysis of solvents, dissociation constants of acids, properties of different solvents, different types of proton transfers, activity coefficients of various solutes, etc. Special attention is paid to local molecular structure of the solvent as well as the effect of various ionic species in breaking down the structure.

This book contains relatively few typographical errors. Well selected problems have been inserted at the ends of many of the chapters, so that the book is suitable for individual study. The worker actively engaged in the study of ions in solution will find this book a valuable addition to his library.

Norman C. Li, Ph.D.
Department of Chemistry
Duquesne University

A Laboratory Manual of Experiments in Physics

• *By* LEONARD ROSE INGERSOLL, MILES JAY MARTIN and THEODORE ALTON ROUSE. Sixth Edition. New York. McGraw-Hill Book Co., Inc. 1953. Pp. XI + 286. $4.00.

Any book that reaches a sixth edition requires little comment from a reviewer. Its success is apparent. We need only say that this is not just another laboratory manual; it is a very good one. Written by members of the physics staff of the University of Wisconsin, its authors have kept it up to date since the first edition was published in 1925. The book, which contains 77 experiments, is planned to fit a variety of laboratory programs in either technical or non-technical fields. There are few if any better Manuals.

A. J. K.

Physics, Principles and Application

• *By* HENRY MARGENAU, WILLIAM W. WATSON, and C. G. MONTGOMERY. Second Edition. New York: McGraw-Hill Book Co., Inc. 1953. XII + 814. $7.50.

This is a good revision of a challenging textbook of college physics the first edition of which was written by three members of the department of physics at Yale University. Designed for physics majors and for students of engineering, it will undoubtedly be as well received as was the first edition. Some of the more difficult sections have been modified so that they may be better understood by sophomores, many new problems have been added, late advances and discoveries such as the cosmotron, the transistor, and thermonuclear processes are now included. As before, the book considers the need of the student who is studying the calculus concurrently. Subjects considered in the first chapters do not require this form of mathematics, and its use is introduced gradually. On the whole, an excellent text.

A. J. K.

Man and His Physical Universe

• *By* RICHARD WISTAR. New York: John Wiley & Sons, Inc. 1953. Pp. XV + 488. $4.75.

This is a college text for non-science majors, but at first glance one might think it designed for secondary schools. Its general make-up, organization, type selection, illustrations, chapter headings and summaries give that impression. There is in it much of sound value, however. Whether or not college students will find it interesting and exciting—a hope expressed by the author—must await classroom trial.

Selected material dealing with chemistry, physics, geology and astronomy is arranged to show the interdependence of the sciences and their applications in daily life. There are six units: Photography; The Solar System and Beyond; The Story of the Earth; Forecasting the Weather; Electricity and Magnetism; and Atomic Structure. Each unit is composed of from six to ten chapters. Some of the units contain useful material not indicated by the unit title. The unit on photography, for example, has chapters on sound and the physical basis of music. The book is illustrated with some 300 unhackneyed photographs and line drawings.

H. C. M.

Chemistry for Our Times

• *By* ELBERT C. WEAVER and LAURENCE S. FOSTER. New York: McGraw-Hill Book Co., Inc. 1954. Pp. 666. $4.12.

It would be a hard-hearted reviewer indeed who would seek to find even minor faults in this attractive textbook in high school chemistry. It was written by men who know their science. Every page shows that they know how to teach it as well.

Ten well chosen units are subdivided into 40 chapters. The sections on atomic structure and radioactivity and nucleonics are especially well done. Thought-stimulating questions and problems are found at chapter ends and groups of questions are scattered throughout each chapter. The material covered in this book is well chosen; the illustrations are superb, some of them in color; and the discussions and explanations are clear and to the point. Physically this text is an example of good book making. Teachers as well as students will welcome it. It is a lot of book for the money.

H. C. M.

The Social Insects

• *By* O. W. RICHARDS. New York: Philosophical Library. 1953. Pp. XIII + 219. $4.75.

Teachers of general science or biology will enjoy this book. So will high school pupils and their parents. To any non-professional, young or old, this book will carry a strong appeal. It is not a textbook. It does not attempt to teach, but it contains a wealth of information, some new, some familiar. Only the social insects are studied. These are those that live in communities and have developed complex societies. They are described in fascinating detail. An introductory chapter discusses insects in general, how they work, what they eat, how they grow and reproduce, and how they behave. Studies of wasps, bees, ants, and termites follow. There is a chapter on social parisites and a concluding chapter on insect societies. A number of photographs and line drawings add to the clarity and interest. We recommend this book to your attention

H. C. M.

Solid Geometry

(Continued from Page 17)

pursued the mathematics program for this length of time he has at least been exposed to, and has had an opportunity to acquire these skills to some degree. Is this justification for making the tenth grade a terminal course in mathematics for most of our students? It has been done, and not always because of limit of abilities.

There is another class of practical values which we might call preparatory. These include a more intense training in the fundamentals, and an appreciation of analytical methods of approaching a problem. While these values are not as apparent nor as immediate as those stated above, they are very real and important to the students who pursue further study of mathematics in the high school or college. The Joint Committee indicates that "advanced work in mathematics finds frequent application, not only in the obvious cases of higher mathematics, engineering and the physical sciences but also in various specialized branches of the earth sciences, the life sciences, the social sciences, commerce and industry, psychology and education, and even in philosophy and aesthetics."

The students of the eleventh and twelfth grades may be grouped as those who will finish their formal education at the end of the twelfth grade, and those who will continue their education through the college. Even within these divisions we have a variety of goals projected. The ideal curriculum would take care of all these categories by offering a course suitable for each goal but none of us will reach the ideal situation. Facilities and lack of sufficient enrollment will prevent this. However, we can and usually do offer a two-fold or a parallel course: one which will suit the needs of those who will not have the opportunity or the desire to avail themselves of further work in mathematics, and a second course for those who will elect to study further branches of mathematics.

But are these courses, as they are offered today, actually performing the functions that they should to educate our youth to think clearly, to reason logically, to compute skillfully?

Let us look at these courses and judge from their content. First, the general mathematics course, which is usually designated "for non-academic students." By its very name and designation it has defeated its purpose in most instances. There has grown up with the development of the high school a social stigma associated with the non-academic or general course. Also, its content is in most cases a review of fundamentals without much purposeful planning. This course is usually offered in the ninth or tenth grade. It thereby loses many of the values it may have had, because the students at this level are not conscious of the need for such review, and since they do not recognize their deficiencies they will have no interest in the course. To them it is just another arithmetic course. How much better it would be to delay this course until the beginning of the twelfth grade or even the last half of the twelfth grade, where the maturity of the pupil helps him to realize the value of such a course.

The second course is that which we term academic or professional. In the usual sequence, this consists of Intermediate Algebra, Trigonometry, and Solid Geometry, each offered as a one-semester course. This is the traditional course proposed by the National Council, and while it has many advantages and affords an excellent preparation for the technical courses of the college or university, it is serving too few of our students. This is especially true of the course in Solid Geometry.

Let us look at the aims of Solid Geometry. They are usually to increase the student's spatial relationship, and to provide practice in practical mensuration problems. Why cannot both these aims be accomplished in other courses? An alert teacher can find many means of developing spatial relationships by examples as they occur in the other mathematical courses, particularly in plane geometry. In studying the many geometry books sold and suggested for high school use, we find very few problems which would even remotely integrate learning and actual life situations for the youth. This course is suitable for the boys' schools where a large number would benefit by it, but the girls find little use for such a course. That the program is not satisfying even the needs of all those enrolled in the professional courses is evident. Anyone who has read the reports published by the testing committees of our Armed Forces must realize that we have not taught our pupils to deal meaningfully with real situations which require the use of number relations. These reports include youth from high school and college levels, students who had taken the academic course as well as those in the general course.

Since only very few students of the twelfth grade are being helped by the Solid Geometry course and since such a large percentage are being deprived of an opportunity that should be theirs in a democratic school system, there is every indication of a need for an adjustment in the present program.

It seems to me there might be two solutions to our problem. The first solution would be to replace Solid Geometry by two one-semester courses. The first course would be for those students who are interested in the further study of mathematics. There are several suggestions made by the National Committee for such a course. One that has been used with a great deal of satisfaction is Mathematical Analysis, which comprises an introduction to the elements of the calculus, analytic geometry, theory of equations, and the concept of probability. The applications are very practical and of much more value for girls than a course of Solid Geometry.

The second course offered in this program may be called a Survey of Mathematics. This course would be open to all those who have had only the elements of algebra and geometry, or neither. It would center around such topics as applications of percentage, insurance, taxes, simple algebraic formulae, analysis of graphical

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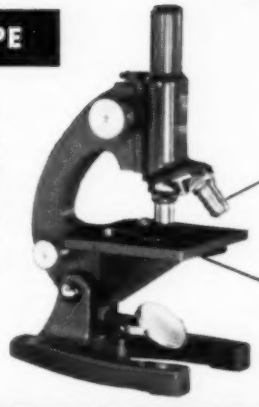

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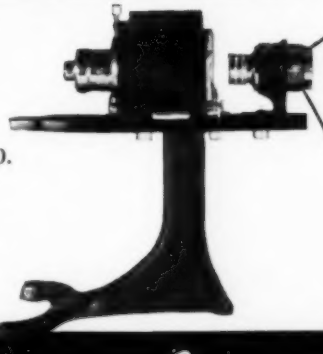

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data and the very useful idea of proportion and variations. The fundamental skills would be re-emphasized and many hazy ideas concerning decimals and fractions could be cleared up at the same time that we develop a practical tool for these boys and girls. Such a course would, of course, eliminate the general mathematics course offered in the ninth or tenth grades, but this would be to the advantage of all concerned, for by this time the student has become aware of his deficiencies in the skillful manipulation of simple number concepts and has a clearer understanding of the need for a knowledge of such topics as those mentioned above in order to live intelligently and to act more wisely in our complex world.

The second solution to our problem would be to require *all* the twelfth grade pupils to take such a course as that outlined in the Survey of Mathematics, either in the first or second half of the senior year. We know that such a course is as necessary for the so-called academic student as for the non-academic student, for we are all familiar with the complaints of professional people and the college professors who cry over and over: "Why don't they teach them simple fractions and decimals?" (It is not that they have not been taught, but that they were taught at a time when the learner was unaware of their value.) Most of us have had experience with the students taking college entrance examinations and achievement tests and know how poorly they do in the Fundamentals of Arithmetic, not to mention algebraic and geometric concepts. Need more be said in behalf of such a course for all the students?

To summarize briefly: we are made aware from every direction that in the field of mathematics we are not meeting the aims of a general education for the large majority of our high school boys and girls. Most of us are agreed that the reason for this is the content of our curriculum: therefore, a reorganization of the courses offered is a primary necessity.

Since it is impossible to teach everything that will be useful and cultural for every student, we must be certain that we have given at least what will be most useful to the greater number of students. Thus, in planning our program only those courses should be included which will afford, according to the means of the school in question, the greatest value for the largest group. In this consideration then it seems only axiomatic that since solid geometry will in most instances serve a very small portion of our pupils and large numbers are neglected by the inclusion of the course, it should be replaced by one which will have definite and immediate values for the greater number. ●

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—PAUL A. MEGLITSCH
Drake University

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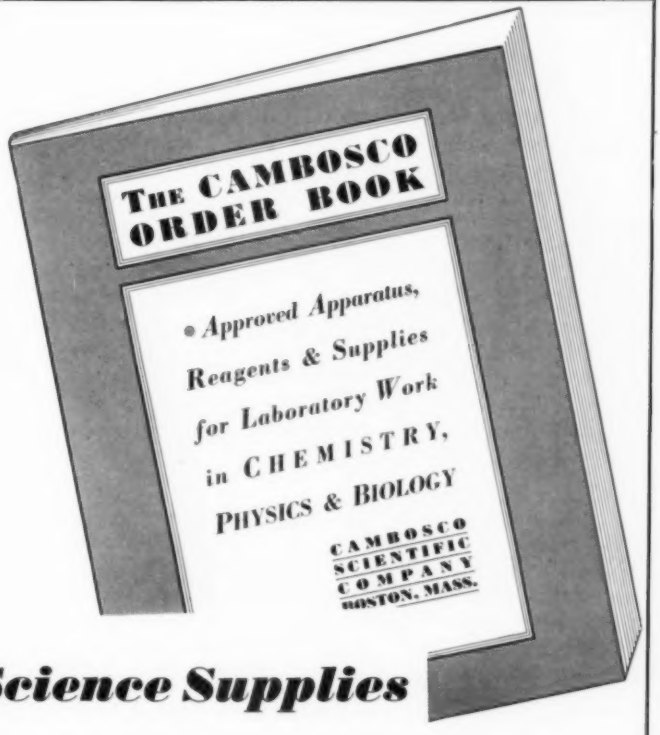
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Human Geography

(Continued from Page 14)

generation were our ancestors confronted with events so momentous, intriguing, and replete with sudden changes as those brought about by World War I and World War II. American men and women are baffled by the task of studying changes which are still rapidly taking place, and of sounding the depths of currents that are still only uncertainly seen on the surface. The unforseen and far reaching problems that loom up month by month in one or another corner of the world make a knowledge of other people and places a starting point for an attempt at the solution of those problems. The greatest steps in its history—steps into the future—are being taken by the United States. Almost against their will the people have become leaders of the Free World,—economically, socially, militarily, politically and financially.

We might suppose, then, that many Americans would be equipped with some knowledge of the lands and peoples of the world in general, and that the United States would lead other countries in the study of foreign lands that modern technology has brought next door, that no country or people could be named for which there was not an American expert.

Unfortunately the real picture is very different from this. Those of us who participated at the beginning of World War II in the frantic search for Americans having even a slight acquaintance with other civilizations and areas suddenly made pressingly important, remember how ridiculously unprepared the United States was for participation, to say nothing of leadership.

Nevertheless, a deeper understanding of the world and its people is the prime requisite of the calm leadership which alone will avert crises.

The shrunken sphere has brought home to us as never before in world history the interdependence of nations. It is a question of economic geography, not a political interdependence agreed, willed, and elaborated. It has come to exist by virtue of a merely technical or material process, not by virtue of a genuinely political or rational process developing at the same time. An adjustment of conflicting political interests must be founded on an intelligent understanding of human geography—of the character of conflicting peoples, the surroundings in which they live, the material resources of which they dispose, the physical or other barriers which divide them, and the communications which unite them. A knowledge of the geographic facts and of how to study them is essential. The political geographer points out the possibilities of a harmonious world, at the same time realistically recognizing reasons for differentiation.

Seven years ago we missed knowing that the situation of the farmers in China would eventually lead to communism, that the landlord, rental, and borrowing

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systems there could not long exist in the modern world. We did not know enough about Malaya, Indonesia, and French Indo-China to appreciate the trends of development in south-east Asia. It is difficult for Americans just now to understand the rising anti-American feeling in Japan in view of the great sacrifices already made by the United States in financial and other aid for the restoration of the Japanese economy. The psychology of a proud people who have suffered such profound defeat is totally foreign to our own experience. After the war we instilled antimilitarism into the Japanese; now we announce to them that mutual security aid will be contingent upon Japanese rearmament. In short, we have completely reversed our foreign policy towards that country within the space of a few years.

In Malaya an attempt is being made to unite three very different ethnic groups—Malayans, Indians, and Chinese into a harmonious whole. This in the face of a serious communist threat to the social, political and especially the economic development of the peninsula. How much do we know about the effect of world economic developments on Malaya's social and economic progress in 1952? What is the background for the statement of the premier of the Republic of Indonesia that he had lost faith in democracy?

Just who are the people of French Indo-China and how do they earn a living? How far will the Annamites there go with the French in forming a new state within the French Union?

The United States cannot long maintain world leadership without knowing the peoples and the countries that it leads. There is no part of the earth in which we are not interested and in which we do not have a responsibility or might have a responsibility in the kaleidoscopic change of world events. After all, were not "Pearl Harbor" and its consequences the ghastly price of American ignorance of Japan and the Far East? A better knowledge of world human geography might avoid another such catastrophe. ●

★ ★ ★ ★ ★

Out of Doors

(Continued from Page 23)

with him; she is chased and must wait until he is finished with his meal.

It seems strange that the Cardinal will chase his own kind, when he does not object to large numbers of other species feeding with him. The Titmouse and Chicadee fly to the feeding stand, select a sunflower seed, and leave very hurriedly to feast in safety in some nearby tree. When the little pugnacious Song Sparrow appears, all other birds are forced to leave until he finishes eating.

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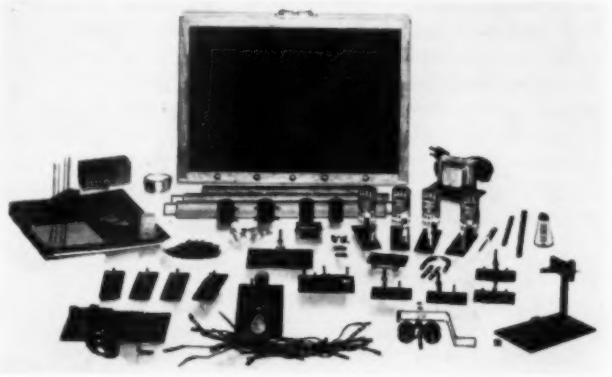

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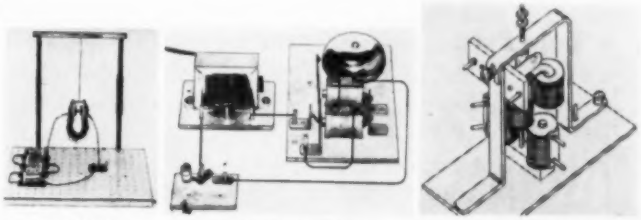

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Plasma Volume Expanders

(Continued from Page 12)

conclusively that dextran is, in fact, metabolized and that more than 90 per cent of the administered dextran has been shown to leave the animal body in a period of ten days. Some of the C^{14} tags are excreted in the urine and others are present in the expired carbon dioxide. It is evident from these experiments that dextran is slowly broken down at some place in the body, undoubtedly by an enzyme process, and that the resulting glucose is then available for nutrition and is added to the normal glucose pool. Thus, dextran affords a small but definite source of nutrition in addition to its properties as a plasma volume expander. This work shows that long term damage or impairment of organ function due to storage is impossible.

Is dextran antigenic? Papers recently have appeared in the literature which have shown that dextran is antigenic when given in minute amounts to human subjects, subcutaneously, under certain very special conditions. It is interesting to find in these papers, however, that one of the premises upon which we based our choice of a simple linear structural type of dextran has been shown to be true, since the less branched and more linear types of dextran cause a smaller amount of sensitization than the more highly branched types. Experiments have shown, however, that when given in large amounts intravenously, the American type of dextran is not antigenic and does not initiate antibody formation. Repeated doses of dextran can be given without fear of anaphylactic shock.

Does dextran expand the plasma volume and thus relieve the symptoms of shock? The treatment of several thousands of shock patients as well as many cases of surgical shock have shown this to be true. Actual measurements of plasma volumes in animals and man demonstrate that large increases in plasma volume do occur when dextran is given, and that the expanded blood volumes persist for some hours.

No man-made product can be considered perfect, but by most scientific criteria dextran of the American type has been shown to be a satisfactory plasma volume expander. For the first time a safe, effective agent which does not depend upon human blood as the raw material is readily available to the medical profession for the treatment of shock. In no sense, however, is dextran or any other plasma volume expander to be considered a substitute for blood. There *is* no substitute for blood; and the need for whole blood will always be with us. It is certain that no plasma volume expander will be found in the forseeable future which can assume the many functions that

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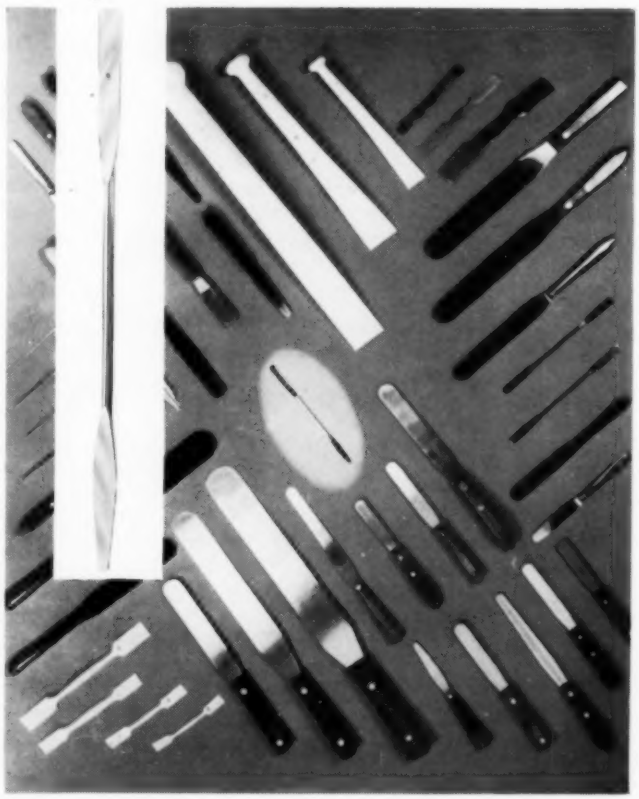

blood is known to have. In war or any other disaster, blood donors will always be needed. A good plasma volume expander, however, can be considered as a replacement for human plasma and will have many but not all of the functions of plasma. Dextran can be used as an emergency treatment when blood is not immediately available, especially in rural areas where there are no blood banks. In many cases dextran alone will be sufficient treatment, and whole blood will be conserved for other patients. In other cases, dextran and blood will be used together, thus conserving the available whole blood.

Dextran as it is now manufactured is not a perfect product and medical scientists are continuing their attempts to improve and to perfect it, and to find even better expanders. But in the coming years dextran or its successor will take its place in medicine as a useful and important drug in peace time as well as in war. ●

★ ★ ★ ★ ★

Solar Energy

(Continued from Page 9)

of the sample at any moment is the result of an equilibrium condition that obtains when the radiant energy absorbed by the sample equals that lost by emission or conduction. By varying the effective aperture of the mirror, the amount of energy, and thus the temperature, can be accurately regulated to within 1 degree, and due to the nature of the source it will remain constant over long periods.

Depending on the character of the substance, the intense concentration of energy in the focus makes it possible to raise the temperature from 20°C. to 3000°C. in a few seconds. In addition, the arrangement of the sample facilitates correspondingly rapid quenching procedures. In closed furnaces, exhalations from the heated walls and other sources tend to introduce impurities that may vitiate the results when accurate melting point measurements or the production of sensitive alloys is desired. Here, however, these conditions are entirely absent, and the sample itself, if of sufficient size, forms the crucible to contain the melt. Furthermore, if a transparent cover of quartz glass is placed over the focal area, work may be carried out under any desired atmosphere or in a vacuum. The polarization resulting from strong electric fields is also absent.

The advantages of this system in the production and study of high temperature alloys is obvious, as is also its value in the determination of the corrosion resistance and insulating properties of experimental materials under intense radiation and in various atmospheres. This instrument has already been used successfully for accurate melting point determinations and in the preparation of equilibrium diagrams for refractory substances[8].

When melting point determinations were the primary object, the sample was prepared in the form of a solid

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block about $2 \times 2 \times 2$ in. Powdered materials could not be handled since no secondary mirror was installed, and the sample was suspended in the focus. Since optical methods were used in temperature determinations emissivity effects had to be accounted for. Blackbody conditions were approximated by drilling or burning a steep funnel-shaped crater into the sample.

Because of the high temperatures encountered in the focus, contact methods of measurement were not practicable and some type of radiation pyrometer was necessary. Actually, a disappearing filament optical pyrometer was used. This instrument was calibrated from 775°C. to 2800°C. in three ranges, with provision made for a fourth range up to 6000°C. by the addition of special filters.

However, before accurate results could be obtained another difficulty had to be overcome. When the pyrometer was focussed upon a heated sample, it registered not only the radiation emitted by the melt but also a reflected part of the concentrated sunlight in the focus. This factor might have introduced an error of several hundred degrees. To obviate this difficulty a double sector system was devised[9]. A study of Fig. 1 will show how this was possible. Two sectors were fastened rigidly to a common shaft. The first was a short tube that swept perpendicularly across the sample and served as an intermittent shield against the incident radiation. The second, in the form of a disc, was placed next to the pyrometer. A small opening in the disc sector was so aligned with the first that when the system rotated, radiation from the melt reached the pyrometer only through the tube of the shield sector, that is, at the instant when the sample was protected from the incident radiation at the focus.

The accuracy of the determinations made by this method was found to be within that of the pyrometer used, that is within ± 5°C. And, in general, it may be said that the solar furnace has now been developed to the point where it will take its place along side conventional furnaces as a research tool[10].

In conclusion, I wish to express my gratitude to Dr. W. M. Conn for his kindness in making available his notes and plates, and for reviewing this article. ●

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Non-College Student

(Continued from Page 7)

A student needs to know how to spend his leisure time; how to develop a hobby. In this adapted course much time will be devoted to projects. These are not to be looked upon as mere time-consuming assignments, but rather as opportunities for creative work in whatever field interests the student. A girl who hopes to become a beautician will be interested in the chemistry of cosmetics. A boy who intends to work in a steel mill may model a blast furnace. Future housewives delve into the chemistry of foods. Many projects offer an opportunity to combine the beautiful in literature, art, and nature, with the practical in chemistry.

Finally, but most important, a student needs to think rationally, to read intelligently and to express his thoughts clearly. The following of detailed directions for putting some idea into concrete form trains him in all these skills. In his creative work he must first distinguish between the practical and the impractical. He must say to himself, for example, "Can I possibly gather the materials for such a project?" Suppose the boy works on a water purification system. He searches for chemicals that will form a coagulate to settle impurities to the bottom of a reservoir. Next, he must find a way of making the water usable for drinking. If he uses chlorine, he learns that it must be used in the correct proportion. He has found out from other experiments that using more or less of a certain chemical may produce an entirely different product than the one he expected.

It is evident, then, that some of the basic needs of a non-college student can be satisfied in such a chemistry course. I insist that such a course is not for slow students, since the group includes only those who do not intend to go to college. The course is not applied chemistry in the sense we understand that term today. It depends more on techniques, methods, and instructional materials than anything else. It requires a teacher who is interested in every student, who knows something about each student's plans for the future—a teacher who will always plan more carefully, study more deeply, work more diligently, and pray more sincerely.

Our students, indeed, are begging for a teacher like this, rather than for a new course. ●

★ ★ ★ ★ ★

It is true that the fear of Communism can lead to excesses, and that many of the actions of self-styled anti-Communists have shown inadequate respect for individual rights. But it is unreasonable to deny that there is a real danger of Communist subversion, or to dismiss all public concern with Communist activity as "hysteria."

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Kolbe Synthesis

(Continued from Page 3)

time evolution of gas had virtually ceased. A constant current of 0.5 ampere (0.05 amp/sq. cm. of Pt anode) was maintained by means of a variac setting in the neighborhood of 20 v, and the temperature was allowed to vary from 11° to 50° C. throughout the reaction. The non-aqueous layer from the reaction mixture was washed in a separatory funnel once with water, thrice with equal volumes of concentrated sulfuric acid, and twice more with water, in order to remove the non-paraffin constituents from the decane fraction. The hydrocarbon layer was then dried and distilled in an all-glass, modified Vigreaux column; the results are recorded in Table 1.

A total of 17.9 g. of *n*-decane which was obtained in Fractions II through V represents a yield of 44 per cent. A freezing point of −30.8°C. was obtained on a 5 ml. sample of the combined fractions II through V, indicating a purity in the neighborhood of at least 94 mole per cent for the major portion of the preparation[4].

TABLE 1.

Distillation of *n*-decane from the Kolbe synthesis

Fraction	B.P. Range °C.	Weight (g.)	n^{25}_D
I	95-150	0.7	1.3967
II	150-162	1.9	1.4071
III	162-165	3.2	1.4076
IV	165-168	9.7	1.4086
V	168-172	3.1	1.4120
VI	172-200	1.4	1.4180

Infrared Spectra of Decane Fractions.—The absorption spectra of fractions II, IV, and V (Table 1) were determined in the region from 2 to 15 microns as represented by curves A, B, and C respectively in Figure 2. Curve D represents the infrared pattern for an NBS sample of *n*-decane (99.96% purity). The spectra were determined with the Perkin-Elmer instrument, model C21, in the liquid phase and with a cell thickness of 0.1 mm.

Conclusions

The electrolysis of caproic acid was carried out in a newly designed Kolbe apparatus and the paraffinic hydrocarbon was isolated and compared to pure *n*-decane by infrared spectroscopy. The spectroscopic as well as freezing point data indicate the absence of any significant amounts of impurity in the electrolytically prepared *n*-decane. It should be pointed out that the infrared pattern for branched-chain hydrocarbons is quite different from those of the normal paraffins.

The homogeneity of the product is in accord with the previously accepted supposition that normal saturated hydrocarbons are the sole paraffinic products in the Kolbe synthesis. This actually lends additional support to the free-radical mechanism for this reaction. ●

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★ ★ ★ ★ ★

A hypothesis is something that we think we may find to be true. As long as this completely reflects our attitude, we are likely to use our hypotheses legitimately. It is so easy, however, for a hypothesis to become something which we expect to find, or even hope to find. As soon as it becomes necessary to qualify the completely colorless *may* with tinges of expectation or desire, objectivity is gone forevermore. Willy-nilly, like it or not, our hypothesis is no longer a legitimate hypothesis and is acting as a preconception, swaying our judgment and, perchance, making prevaricators of our sense organs.

—PAUL A. MEGLITSCH
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Cultivation of Food Plants

(Continued from Page 2)

lated dew period. Roots exuded water vigorously, sometimes more than a pint over a two-week period, while plant growth was vigorous. In some cases water stopped accumulating after a few days; in others it continued for several weeks in quantities that varied from day to day.

In order to avoid a confusing complexity in the initial experiments, no nutrients were given the plants, but shoots continued to grow normally while their food reserves permitted. As their stored nutrients were used up, the plants declined. Only in two experiments, one with tomatoes and another with beans, were fruits obtained. Experiments are now in progress with initially unstunted, unwilted plants and with plants which are receiving from time to time nutrients supplied to the soil in their containers.

To determine the quantitative significance of dew in relation to its deposit on plants, Duvdevani several years ago developed a simple, easily-read dew gauge which has become a standard instrument for use in such research. Dew forms on the gauge during the night in certain patterns. Each pattern is characteristic of the amount of dew and is identified by comparison with standard dew photographs.

Hundreds of such gauges have been distributed throughout Israel, and systematic dew records have been obtained there for a number of years. They are also in use in several other countries, and more than thirty have been set up on the California Institute of Technology campus, at the Los Angeles State and County Arboretum, and in other Southern California locations.

Daily observations over a long period of time will show the distribution of dew in different localities, and correlations can then be made with phenomena of growth and vegetation.

It is already evident that dew may be a deciding factor under critical drought conditions when even a small amount of water can determine whether a plant dries up or lives through a dry spell. Further study is expected to show how much of a plant's water requirements is supplied by dew, what types of plants can use dew most advantageously, and in what environment and stage of their development dew is most effective for those plants. ●

★ ★ ★ ★ ★

The public has the right, through its legally constituted representatives, to inquire into the Communist party membership of individuals. Legitimate and "non-hysterical" criticisms of the methods of such inquiries are in order; ways must be found to protect loyal people from irresponsible charges. But improvement is not likely to come from negative attitudes of non-cooperation.

—LEWIS WEBSTER JONES
Rutgers University

Science - A Cornerstone

(Continued from Page 6)

engineering. Of it Dean Sinnott[8] writes, "To be a whole man the scientists must cultivate both the mind and the spirit. Never in the history has this been needed more desperately than today. The crisis that confronts us is not an ordinary one. This crisis has arisen from the fact that the intellectual achievement, as expressed in the progress of science, has been able to outrun the moral and esthetic qualities of man."

This cornerstone has become a "20th century must" for the world family of nations in this chemical century. ●

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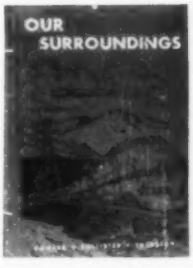

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A General Science Textbook for Grade 9

This latest edition (copyright 1953) of a popular textbook in General Science is written expressly for use either as the top book of a three-year course, or for schools that require a one-year course in General Science. The simplicity and clarity of its language, as well as the completeness of its coverage, make it outstanding as a classroom text. In addition to many splendid teaching and learning aids in each unit, periodic reviews effectively retain the facts taught. Other unusual features are brief biographies of famous scientists, and a glossary of 1100 basic scientific terms.

OUR SURROUNDINGS is beautifully illustrated with a profusion of photographs and diagrams.

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NEW YORK CHICAGO ATLANTA DALLAS

Elementary Science Project

(Continued from Page 21)

at one time. No color was applied until all the plants and animals had been completely sketched. Since each plant or animal was colored by the same person who originally sketched it, each pupil had a hand in the completion of at least one item in the project.

When the plants and animals were finished, the water and sky were colored by those members of each committee who were up to date in their other classroom work. Again, the limit of two workers per panel was set.

When it was completed, the frieze was coated with a plastic spray for semi-permanent protection.

Each of the twenty-one members of the class contributed to every phase—planning, research, and execution—of the project. From inception to completion, making the frieze took three weeks' time. The time was well spent.

Note by the Editor:

The frieze described in this article was displayed for several weeks during the summer session and the fall semester in the Elementary School Department of the School of Education of Duquesne University. It attracted much favorable comment. We are sorry that it loses so much of its beauty in black and white reproduction.

The following comments, came direct to the Editor from three of the participating pupils:

Mary Ann Chiarella writes:

"In making the frieze I did some of the sky, some of the water, the cattails, the marsh grass and the sucker. I learned many things about them including how they live, how they eat, how they work, what kind of homes they have, and what they do."

Mary Ann Burdge reports:

"One day our teacher told us to choose a subject we would like to study. We all agreed to study Pondlife. We brought in animals from the ponds and streams and lakes, eels and fairy shrimp, crawfish, turtles, fish, snails and toads and water cocoons, and many different kinds of things. We learned how fish and other animals live in ponds."

"So one day we were so interested in what we were doing that Mr. Vroom asked us if we would like to make a frieze. We all agreed. He sent a piece of paper around and we put our names under which Zone we wanted to be in. He saw which Zone we wanted to be in and he put the Land Zone people in one group, the Water-lily Zone people in another group, and the Reed Zone people in another group. We picked out the animals we wanted to draw. When we finished drawing them on a small piece of paper to see how big they should be, we could go up to the frieze and draw our animals and plants. That's how we made our frieze."

Jacqueline Winters says:

"We learned how some animals changed their forms from eggs to adults. We made all sorts of animals. We enjoyed working on our science frieze." ●

FREE LIST

Teachers of Elementary Science will be glad to know that a free list containing catalog numbers of laboratory apparatus and supplies used in teaching elementary science is now available from the Central Scientific Company, Department ADG, 1700 Irving Park Road, Chicago 13, Illinois. It contains suggested apparatus and materials based on the bulletin published by the Office of Education, United States Department of Health, Education, and Welfare: "Teaching Elementary Science," Bulletin No. 4, Reprinted 1953.

★ ★ ★ ★ ★

Universities, both public and private, are strongly affected with a public interest. They occupy a position of central importance in our free society, embodying our highest aspirations, and our hope for material and spiritual progress. They are at once the most characteristic expression and the principal guardians of the Western tradition of freedom. They are charged with the preservation of cultural heritage, the discovery of new knowledge and its dissemination, the education of young people as persons, workers and citizens. They cannot confine themselves to techniques, and adopt an attitude of neutrality and withdrawal in the face of the central moral issues of our times. They must teach with conviction; they must not abdicate the larger intellectual and moral leadership which has been their historical function, and on which their claim to freedom rests.

—Lewis Webster Jones
Rutgers University

★ ★ ★ ★ ★

All this suggests that if the objective of education is the development of knowledge about a topic or field, the lecture is a far more efficient method of communicating such knowledge and of securing the attention of students to these ideas than is the discussion. However, if the objective is the development of abilities and skills which are problem-solving in nature, the least efficient discussion is superior to most of the lectures.

—B. S. Bloom
University of Chicago

★ ★ ★ ★ ★

The development of a science is more or less analogous to a battle—to a war of attrition, as it were, fought on two fronts. On the one hand, the enemy is total ignorance, while, on the other, it is that semi-informed ignorance which is exemplified by "knowledge" based upon insufficient or invalid data. The fighting is no less fierce on the second front, for we are all too often reluctant to part with ideas that have acquired the authority of long existence, even though they lead us into compromising and erroneous positions.

—Paul A. Meglitsch
Drake University

Celsius Versus Centigrade

The Ninth General Conference on Weights and Measures, held in 1948, adopted the name "Celsius" for the scale of temperature which has more commonly been called "Centigrade." This action, which had not been proposed in advance of the Conference, arose from a question regarding preferred usage in French, the sole official language of the Conference. The decision therefore may be considered as applying strictly only to that language. In the interest of eventual uniformity of practice the use of "Celsius" appears desirable, but it is not practicable to impose this term of those who prefer "Centigrade."

In preparation for the General Conference the National Bureau of Standards submitted a revised text defining the International Temperature Scale to supersede that adopted in 1927. The proposed text was drafted in English and, in accordance with common English practice as well as the official French text adopted in 1927, it used the name "Centigrade." This name was carried over into the French translation prepared for consideration by the Advisory Committee on Thermometry in May, 1948. However, in the printed report of that meeting, the term "Centigrade" had, in most cases, been changed to "Centésimale," the term that is used in the French law governing weights and measures. When asked to choose between the two, the International Committee on Weights and Measures and the General Conference voted to substitute "Celsius."

With regard to the merits of the decision it may be remarked that Celsius (abbreviated C) is analogous to the names Kelvin, Fahrenheit, Réaumur and Rankine used for other temperature scales, that it has previously been used considerably in some countries, and occasionally in America, being included in Webster's dictionary. It might also be argued that "Centigrade" is logically ambiguous, since the absolute Kelvin scale, as well as the "Centigrade" scale, has 100 degrees between the ice point and the boiling point of water. On the other hand, the name "Centigrade" is thoroughly established in English-speaking countries, the need for choosing between that name and "Centésimale" arises only in French, and the decision on a term in the official French language of the Conference may not be considered as controlling the terms to be used in translating into other tongues. ●

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A. C. S. Examinations Committee Announces Two New Tests This Year

Two new examinations are featured in the national college testing program of the Examinations Committee of the A.C.S. Division of Chemical Education.

General Chemistry Test, Form K, is the new test in general chemistry. It has been constructed by Dr. Conrad Ronneberg of Denison University and 15 collaborators. The items selected by the committee have been further appraised by a group of thirty teachers in colleges and universities throughout the country. Items in it have been checked for validity under actual classroom conditions. This test should prove to be a very valid one for measuring achievement in freshman chemistry and as a proficiency test for advanced students.

Biochemistry Test, Form K, is the other new test. It was constructed by Dr. Gordon H. Pritham of Penn State University with a committee of 18. The items in this test are distributed on the basis of a survey of courses in biochemistry and include items on new fields such as antibiotics and chemotherapy. It should prove a thorough test for both one-semester and two-semester courses.

These two tests are part of the spring testing program sponsored by the Examinations Committee. In the program the following tests are featured:

General Chemistry: Form 1948, Form Z, Form G, Form K (new test)
Qualitative Analysis: Form Y, Form H, Qual. Supplement Form J
Quantitative Analysis: Form X, Form Y, Form G
Organic Chemistry: Form Y, Form H
Biochemistry: Form X, Form Z, Form K (new test)
Physical Chemistry: Form W

Further information and copies of the tests may be obtained from Dr. Theo. A. Ashford, Committee Chairman, St. Louis University, St. Louis 4, Missouri. Limited copies of older examinations are available in addition to the tests featured in the testing program.

The Examinations Committee Testing Program has shown much growth in recent years. Over 47,000 students in 448 colleges and universities in the United States and several foreign countries were tested under this program last year. Many more are expected to participate this year with the publication of the new tests.

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Science is always moving away from its past. New discoveries, while adding to the treasure of our knowledge, at the same time reveal wider fields of our ignorance. As a consequence, what seemed to form the end of an inquiry just means the possibility of a new beginning.

—EDWARD FARBER
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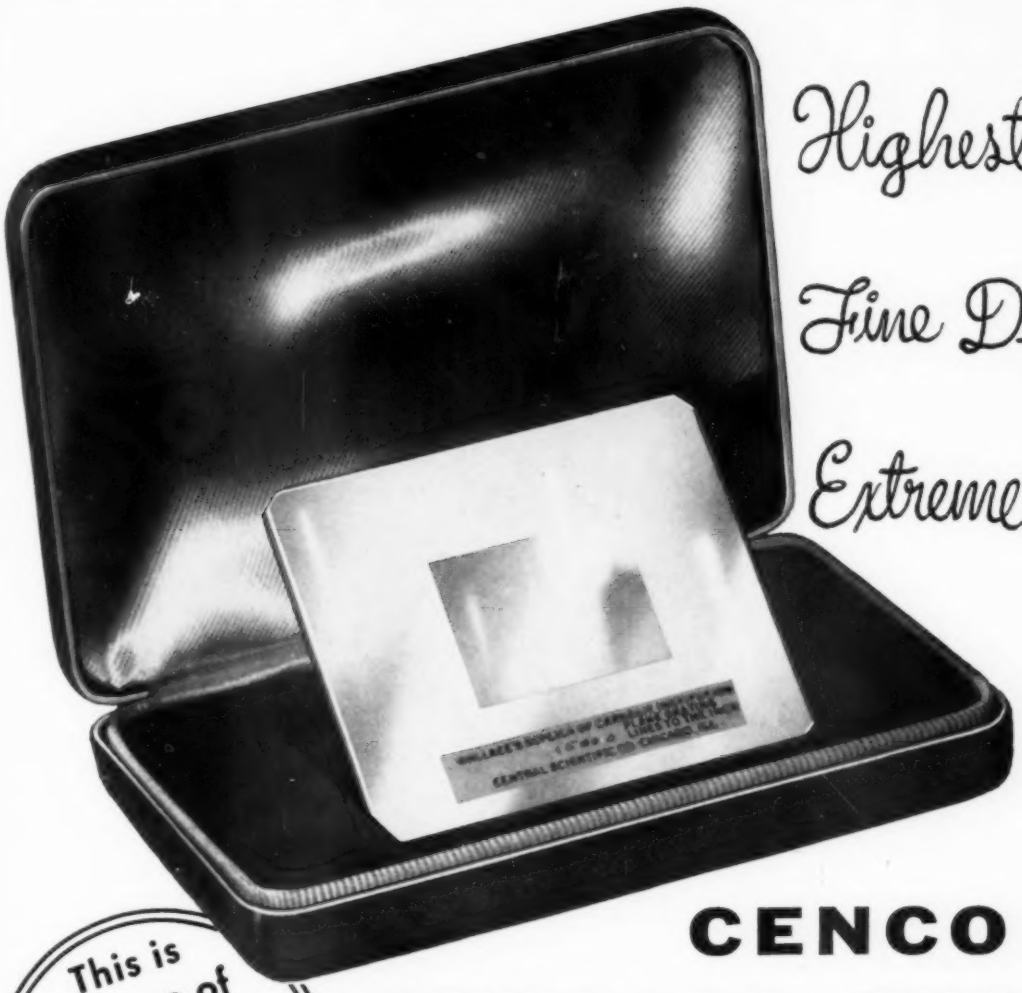

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